

CLIMATE CHANGE ADAPTATION IN MYANMAR

(Facilitator Guide)



MCCDDM



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Climate Change Adaptation in Myanmar



Table of Contents

Acronyms and abbreviations	ii
Introduction	1
Background	1
Aim and objectives of the course	1
Course overview and modules	2
Planning on-the-job exercise and field visit	3
How to use this Training User Manual	3
MODULE 1	5
Understanding climate change	
Session 1.1 : Introduction to the course	5
Session 1.2 : Basics of climate change science	6
Session 1.3 : Observed and projected climate changes in Myanmar	16
Session 1.4 : Key terms and concepts	20
MODULE 2	27
Addressing current and future impacts of climate change in Myanmar	
Session 2.1 : Climate change vulnerability and policy response	27
Session 2.2 : Impacts and adaptation: ecosystems	35
Session 2.3 : Impacts and adaptation: socio-economic systems	41
Session 2.4 : Impacts and adaptation: infrastructure and human settlements	47
Session 2.5 : Cross cutting issues: gender and DRR.....	51
MODULE 3	57
Assessing vulnerability to climate change and hazards at a local level	
Session 3.1 : Vulnerability assessment: purpose and methodology	57
Session 3.2 : Practical exercise: rapid vulnerability assessment	74
MODULE 4	79
Preparing Local Climate Resilience Action Plans	
Session 4.1 : Preparing local climate resilience action plans: process and methods	79
Session 4.2 : Strategic planning exercise	88
References	90
Annexes	91
Annex I : Climate change in Myanmar: key indicators, observed trends and future projections	91
Annex II : Potential climate change impacts	93
Annex III : Long list of local climate change adaptation options	96
Annex IV : Sample questions for exploring gender-differentiated vulnerability to	112
climate variability and change in townships of Myanmar	
Annex V : Hand-outs and tools for group exercises	114

Acronyms and abbreviations

AR5	Fifth Assessment Report
CCA	climate change adaptation
CH4	methane
CO2	carbon dioxide
DRM	disaster risk management
DRR	disaster risk reduction
ECD	Environmental Conservation Department
ENSO	El Niño-Southern Oscillation
GAD	General Administration Department
H2O	water vapour
IPCC	Intergovernmental Panel on Climate Change
MCCA	Myanmar Climate Change Alliance
MCCSAP	Myanmar Climate Change Strategy and Action Plan 2016-2030
MIMU	Myanmar Information Management Unit
MNREC	Ministry of Natural Resources and Environmental Conservation
MSWRR	Ministry of Social Welfare, Relief and Resettlement
N2O	nitrous oxide
NAPA	National Adaptation Programme of Action
O3	ozone
ppb	parts per billion
ppm	parts per million
RCPs	Representative Concentration Pathways
RRD	Relief and Resettlement Department
SWOT	strengths, weaknesses, opportunities and threats
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-Habitat	United Nations Human Settlements Programme

INTRODUCTION

Background

The Myanmar Climate Change Alliance (MCCA) was launched in 2013 with the joint efforts of the United Nations Human Settlements Programme (UN-Habitat), the United Nations Environment Programme (UNEP), the Ministry of Natural Resources and Environmental Conservation (MNREC) and its Environmental Conservation Department (ECD). The programme also works closely with several other ministries and government agencies, including the Ministry of Social Welfare, Relief and Resettlement (MSWRR) and its Relief and Resettlement Department (RRD). The overall objective of MCCA is to mainstream climate change into the policy development and reform agenda of Myanmar.

The country is highly vulnerable to climate change and hazards. At a local level, climate change is already resulting in more frequent and severe disasters such as devastating cyclones, frequently recurring floods and storm surges, droughts and consequent climate driven migration, and loss of productivity in the agriculture sector, among others. In the context of increasing climate-induced risks, local administrations need to enhance their capacities for climate change adaptation (CCA) and disaster risk reduction (DRR). In response, MCCA and ECD designed a training course entitled “Building Local Level Resilience to Climate Change in Myanmar”.

Aim and objectives of the course

The overall aim of the training course is to build the capacity of national and local governments for integrating CCA and DRR measures into local development plans. The course modules are tailored to equip government officials with robust knowledge on climate change and its impacts in Myanmar, as well as with analytical and technical skills on how to develop local CCA and DRR strategies and plans based upon vulnerability assessments.

The course pursues the following specific objectives:

- to improve the knowledge on climate change including on approaches and frameworks for CCA;
- to understand characteristics and identify impacts of observed and projected climate changes in Myanmar and linkages with sustainable development of townships;
- to identify, assess and integrate suitable CCA measures into township development plans;
- to understand and address key cross-cutting issues in CCA, such as gender and DRR.

The training is intended for:

- Selected township-level administrators, including General Administration and members of Townships Development Committees;
- District and townships representatives from various sectoral ministries/departments;
- National and regional representatives of ECD, RRD, and the Meteorology and Hydrology Department;
- GIS specialists from various ministerial units such as those from MNREC.

Course overview and modules

The course consists of four modules. Each module is comprised of theoretical part and group exercises that lead participants step-by-step through the process of developing local climate resilience action plans based upon vulnerability assessment. The course outline is provided below.

Module 1: Understanding climate change

The development and implementation of climate change policies in Myanmar necessitates strengthening the knowledge and expertise of government officials in this field. Recognizing that climate change is a complex notion the first module of the training course is aimed at introducing participants to the basic terms and concepts used in the climate change science. The module further aims at enhancing practitioner's knowledge on the anthropogenic factors associated with climate change, as well as on the current and projected climatic changes at the global and national levels.

Module 2: Addressing current and future impacts of climate change in Myanmar

Myanmar is highly exposed to rapid- and slow-onset climate-related hazards. The country's economy is largely dependent on climate-sensitive sectors such as agriculture, water and energy, and on depleting natural resources. Therefore, national and local governments should have the capacity to understand and address present and future impacts of climate change in Myanmar. With this objective, Module 2 of the course focuses on the impact of climate change on key sectors, and informs participants on various CCA measures applicable at the local level with reference to the Myanmar Climate Change Strategy and Action Plan 2016-2030 (MCCSAP). In addition, the module teaches on techniques for analysis of climate change impacts at the local level, which is an essential element of climate change vulnerability assessment.

Module 3: Assessing vulnerability to climate change and hazards at a local level

This module introduces participants to the process of, and methods/tools for conducting climate change vulnerability assessments at a township level. The module consists of a theoretical part and practical work (simulation exercise and a filed visit).

Module 4: Preparing local climate resilience action plans

The module builds upon the results of the vulnerability assessment conducted in Module 3. The aim of the sessions within this module is to enable participants to prioritize adaptation measures and develop local resilience plans. More specifically, the focus of the training is on: (i) discussing the objectives, purpose and structure of an action plan; (ii) providing guidance on the whole planning process, such as where to start from (forming a team; setting objectives, budget and time-frame; identifying key stakeholders, etc.); (iii) introducing methods for analysis of strengths, weaknesses, opportunities and threats (SWOT) in the context of adaptation planning and setting clear CCA objectives; (iv) identifying a short list of adaptation measures and prioritizing adaptation options.

The course is designed to provide flexibility in terms of content and duration (minimum 3 days and maximum 7 days). It is recommended that participants should not exceed 30 people to ensure good quality training. Suggested methods of teaching include lectures (30%), group exercises (60%), and a field survey (10%). Assessment of the effectiveness of teaching will be conducted through question-answer sessions and group exercises.

The training course applies Adult Learning principles and uses various tools such as PowerPoint presentations and lectures, case studies from Myanmar, group and open discussions aimed at sharing experience and knowledge, as well as simulation exercise and a field work.

Planning on-the-job exercise and field visit

A real case study, including a field visit, are foreseen as part of the training with the objective to train participants on how to analyse secondary data and use participatory tools for vulnerability analysis. Therefore, while planning the course, facilitators should consider the following issues:

- Select a case study, e.g. a town, village or small community located in the area where this course takes place. Ensure that field visit work is realistic in terms of time and planned activities.
- Request basic secondary data for the selected case study necessary to develop town/village profile (sources of data are listed in Module 3/Session 3.1). If possible, collect the following data and create a spreadsheet table (e.g. in Microsoft Excel): population data disaggregated by sex and age, level of education completed, income per capita, employment rate, type of housing units, household access to drinking and irrigation water.
- Where possible, work with different social groups and engage women and youth. Women's groups might be better facilitated by women.
- Ensure to prepare all materials necessary for the field visit (e.g. maps, flip charts, transparent paper, markers, sticky notes). Refer to Module 3/Session 3.2 for more details.

How to use this Training User Manual

This Training User Manual is intended to guide trainers/course facilitators step-by-step throughout the course "Building Local Level Resilience to Climate Change in Myanmar". The following sections provide detailed guidance on the course content presented in the following format:

- Introduction to session, which is intended to introduce the trainer to the content and objectives of each thematic session, and provide overall guidance and recommendations.
- Training content for each session in line with the PowerPoint slides and notes.
- References for further information if needed by Facilitator.
- Supplementary materials for each module such as quiz questions and answers, and materials for group activities and simulation exercises.

MODULE 1

UNDERSTANDING CLIMATE CHANGE

Session 1.1 : Introduction to the course

Duration	:	90 minutes (two blocks of 45 minutes)
Training methods	:	discussion, video, presentation, pre-course test
Material required	:	Projector, Screen, PowerPoint slides and notes

This session aims at creating interactive and friendly learning environment for participants by raising a discussion on their understanding of climate change. The course organization, learning objectives and teaching methods are also presented.

Training content

Is the climate really changing?

There is a strong scientific evidence of global warming that alters the Earth's climate and impacts human livelihoods. For example, changes in temperature and precipitation patterns significantly affect agricultural production worldwide, while sea level rise threatens the livelihood of millions of people inhabiting low-lying coastal areas around the globe.

In Myanmar, climate change has already resulted in increasing severity and frequency of: (i) extreme events such as tropical cyclones, heavy rains and flooding, heat waves and drought events; and (ii) coastal hazards such as severe storm surges, among others. In the meantime, the country's socio-economic development is highly dependent on sectors such as agriculture and fisheries, forestry and hydropower energy production, all of which are highly sensitive to the adverse effects of climate change.

Case studies, practical exercises and field work

In 2016, comprehensive vulnerability assessments to climate change in the Central Dry Zone (Pakokku) and the Delta Zone (Labutta) were conducted under the activities of the MCCA Programme. As a result, policymakers from the two townships developed Township Adaptation Plans. The process, methods and tools applied in the two case studies were used for the development of Modules 3 and 4 of this course. Using the same approaches, participants will conduct rapid vulnerability assessment for a selected case study.

Session 1.2 : Basics of climate change science

Introduction to the session

Duration	: 135 minutes /three blocks of 45 minutes/
Training methods	: Lecture and discussions
Materials required	: Projector, screen, PowerPoint slides and notes

This session explains the basic terms used in the climate change science, as well as the key natural and anthropogenic factors associated with climatic changes and the global warming. It also introduces observed changes in the climate in recent years, and projections of future change as summarized in the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC).

At the end of the session, participants will be able to:

- Explain the difference between *weather* and *climate*, and climate change and *climate variability*.
- Describe the natural and anthropogenic factors associated with climate change.
- Identify main sources of greenhouse gas emissions in Myanmar, and provide examples of mitigation actions.
- Disseminate to others the evidence of climate change in recent years.
- Explain to others why climate change is believed to be a result of human activities.
- Explain the global observed and projected climate changes, including rapid- and slow-onset events.
- Explain why Myanmar should mitigate climate change and adapt to its impacts.

Key points covered : climate system; difference between weather and *climate*; difference between climate change and *climate variability*; natural causes of climate change; anthropogenic causes of climate change; greenhouse effect; major greenhouse gases; observed and projected climate change; climate change adaptation and mitigation.

Training content

Climate system

The climate system is a complex system consisting of five major components including the *atmosphere*, *hydrosphere*, *cryosphere*, *land surface* and *biosphere*, and the interactions between them.

The atmosphere is a layer of gases surrounding our planet, and composed of about 78 per cent nitrogen (N_2), 21 per cent oxygen (O_2), 0.9 per cent argon (Ar), and other gases such as carbon dioxide CO_2 , water vapour (H_2O), methane (CH_4), as well as ozone (O_3) and aerosols (airborne solid or liquid particles, that reside in the atmosphere for at least several hours). The hydrosphere is comprised of liquid surface and subterranean water (e.g. oceans, seas, rivers, freshwater lakes, underground water), while the cryosphere consists of all snow, ice and frozen ground (including permafrost). The biosphere refers to all ecosystems and living organisms in the atmosphere, on land or in the oceans.

Weather

Weather refers to a condition of the atmosphere at a certain time and location described by meteorological variables such as temperature, precipitation, wind, humidity, atmospheric pressure, cloudiness.

Example: What will be the weather in Yangon next Monday?

Climate

The average weather conditions in a certain location at a given time of the year, measured as a statistical average of local temperature and/or precipitation over a period of at least 30 years.

Example: What is the climate in Myanmar in September?

Climate variability and climate change

The state of the climate system (including its components, processes and interactions), as well as external factors which influence the environment, alter the Earth's climate (Figure 1). Therefore, *climate varies spatially and temporally* depending on:

- geographical factors (e.g. topography of the terrain, closeness to large water body, vegetation cover) and seasonal variations;
- changes in ocean-atmosphere circulations such as the El Niño-Southern Oscillation (ENSO);
- natural external forcing processes such as solar output variability, orbital variations, the motion of tectonic plates, and volcanic eruptions;
- human activities, which influence the environment.

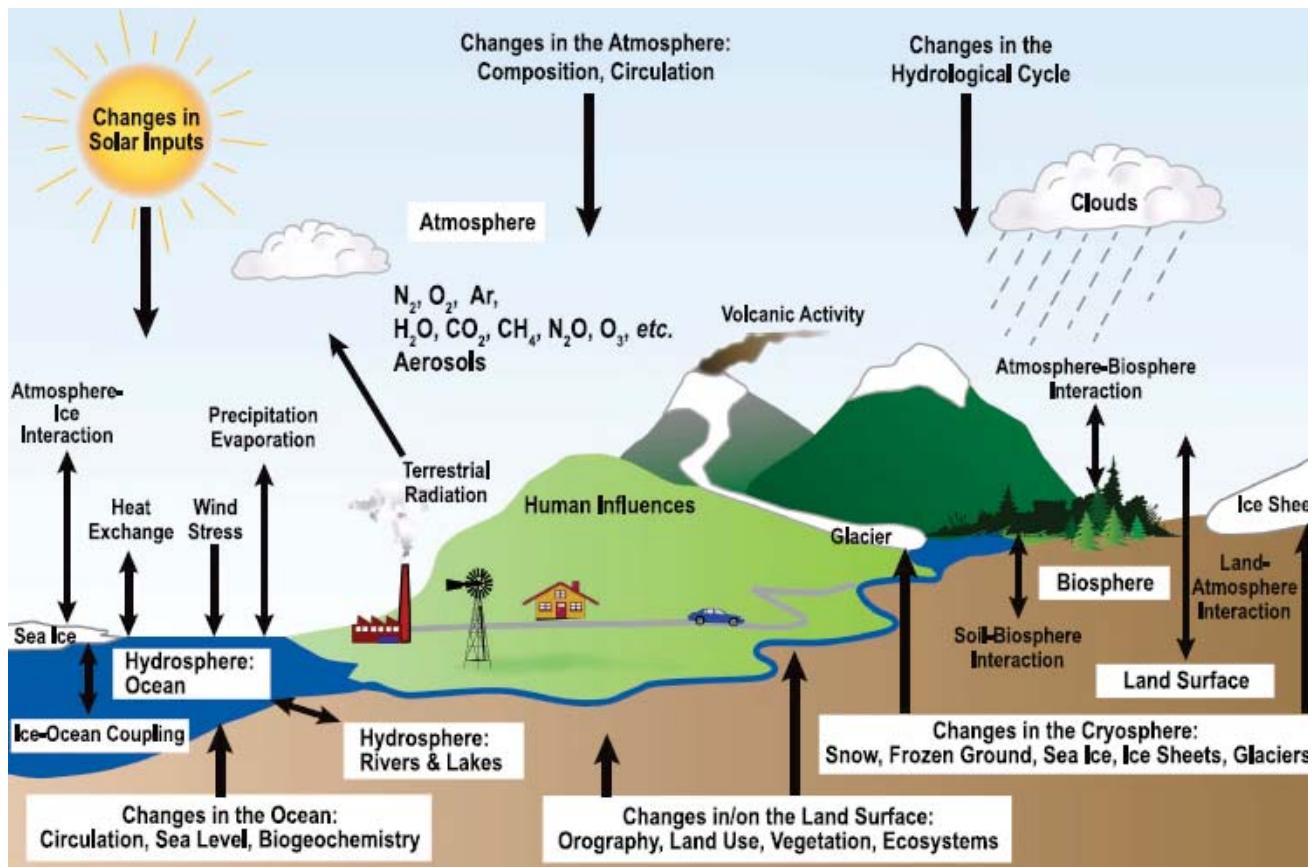


Figure -1 : The climate system (Source: IPCC, 2007)

What is ENSO?

ENSO events are a coupled ocean-atmosphere phenomenon, which occur about every 2 to 7 years, and affect global mean temperatures as well as wind and precipitation patterns. The warming phase of ENSO is called El Niño and the cold phase La Niña. El Niño involves warming of tropical Pacific surface waters and is associated with large precipitation variations (e.g. a decline in global monsoon precipitation is observed during El Niño events). In contrast, La Niña brings cooler- and wetter-than-normal conditions.

In future, ENSO related precipitation variability on regional scales will likely intensify.

Observed impacts of El Niño in Myanmar include: decline in precipitation, greater variability of monsoon rainfall, and occurrence of drought spells and heat waves. La Niña increases the risk of disasters associated with abnormal rainfall such as floods and landslides.

[IPCC, 2007; IPCC, 2014; Horton, R. et al. 2016; NMREC, 2012(b)]

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate, attributed either to natural internal processes within the climate system, or to variations in natural or anthropogenic variables. In other words, climate variability refers to the annual fluctuation of the climate, above or below the long-term average. ‘An average climate’ could be explained as ‘a typical climate’, e.g. typical temperatures and rainfall in wet season in Myanmar. In contrast, climate variability is ‘a not typical climate’. For example, some dry seasons in Myanmar are cooler than others.

Climate change is statistically significant change in the state of the climate including the mean and/or the variability of its properties such as changes in temperature, precipitation and wind patterns, that persists for a long period of time (typically decades or longer). To simplify, climate change suggests long-term continuous change of:

- the ‘typical climate’, e.g. average (‘typical’) seasonal temperatures in the coastal zone of Myanmar are getting higher;
- variability of temperatures, precipitation, and other climate parameters, e.g. more frequent and severe rainfall and stronger winds are observed in some regions of Myanmar.

Drivers of climate change

Climate change is driven by natural processes (greenhouse effect, solar output variability, orbital variations), and/or by persistent anthropogenic changes (e.g. increased greenhouse gas emissions, deforestation, over-exploitation of freshwater resources) in the composition of the atmosphere or in land use.

The Earth's temperature depends on the balance between the solar energy entering and leaving the planet's system. When incoming energy from the Sun is absorbed into the Earth's system, then the Earth's surface warms. Greenhouse gases such as carbon dioxide (CO_2), methane (CH_4), water vapour (H_2O), nitrous oxide (N_2O) and ozone (O_3) absorb energy, and slowdown or prevent the loss of heat back to space. In this way, greenhouse gases act like a blanket, making the Earth warmer than it would otherwise be. This process is commonly known as the “greenhouse effect” (Figure 2).

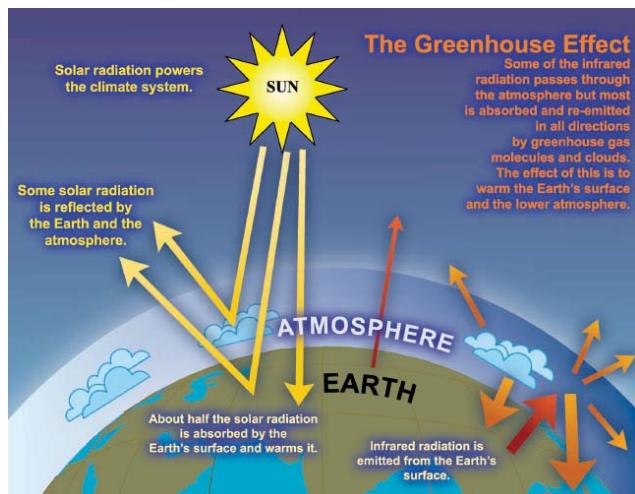


Figure 2 : Natural greenhouse effect
(Source: IPCC, 2007)

The greenhouse effect is a *natural process* that supports life on our planet. However, increased emissions and release of greenhouse gases lead to significant increase in their concentration in the atmosphere. This process is further exacerbated by the reduced capacity of our forests to absorb more carbon than it is released in the atmosphere (process known as carbon sink) due to deforestation at an unprecedented rate. Consequently, the Earth is warming at a fast pace.

Global warming is a recent and ongoing rise in global average surface temperature, which is causing climate patterns to change. The global surface temperature is an estimate of the global mean surface air temperature taking the global average of the sea surface temperature and land surface air temperature.

There is a strong scientific evidence that anthropogenic greenhouse gas emissions have increased the greenhouse effect and caused rapid rise in the Earth's surface temperature. Since the beginning of the Industrial Revolution¹ in 1760, human activities have contributed substantially to climate change by adding CO₂ and other heat-trapping gases to the atmosphere (Figure 3). From 1750 to 2011 the atmospheric concentration of CO₂ increased by 40 per cent from 278 parts per million (ppm) to 390.5 ppm, CH₄ increased by 150 per cent from 722 parts per billion (ppb) to 1803 ppb, and N₂O by 20 per cent from 271 ppb to 324.2 ppb. Furthermore, the current concentrations of these three gases in the atmosphere are the highest for at least the past 800,000 years, whereas the average rate of increase over the past century is the highest for the last 20,000 years (IPCC, 2013).

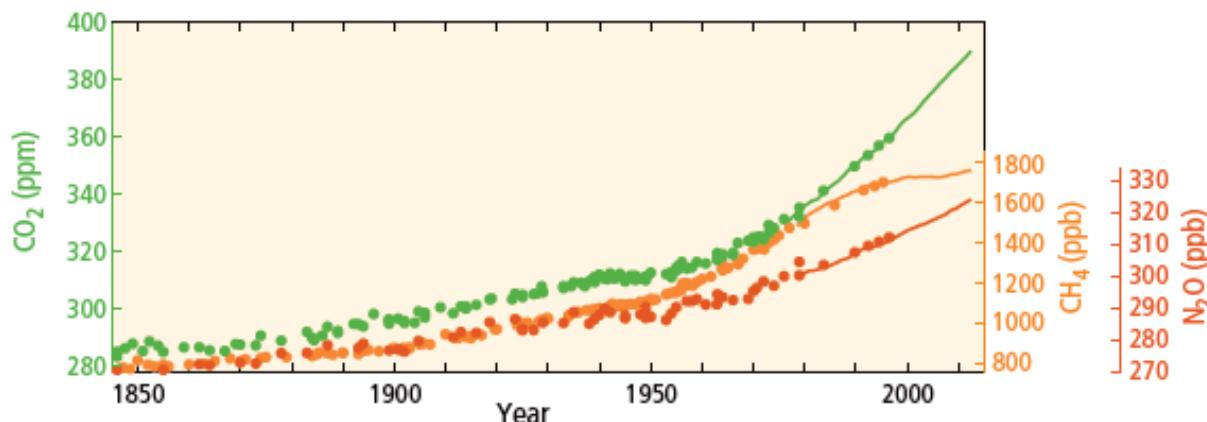


Figure 3 : Globally averaged greenhouse gas concentrations (Source: IPCC, 2014)

According to AR5 of IPCC (IPCC, 2013), sources of greenhouse gas emissions include:

- CO₂ is the primary greenhouse gas contributing to recent climate change. It is absorbed and emitted naturally as part of the carbon cycle, through plant and animal respiration, volcanic eruptions, and ocean-atmosphere exchange. However, dominant cause of the observed significant increase in CO₂ over the last century are emissions from energy production (e.g. burning of fossil fuels), and land-use change through deforestation (Figure 4).
- CH₄ is released in the atmosphere through natural wetlands emissions, agricultural activities (rice production and livestock) and waste, fossil fuels and biomass/biofuel burning, as well as natural geological leaks. Estimations suggest that human activities contribute between 30 and 65 per cent to the total emissions of CH₄.
- N₂O is produced through natural biological processes (emissions from soils and oceans) and human activities (e.g. application of nitrogenous fertilizers in agriculture, fossil fuel and biomass burning, industrial production).

¹ The First Industrial Revolution (1760-1820/1840) started in Great Britain and is known for transition from hand labour to use of machine tools, introduction of chemical manufacturing and iron production, among others. The Second Industrial Revolution (1870-1914) was a rapid technological revolution. Both revolutions had significant environmental impacts particularly pollution of the air, and soil and water resources.

Climate Change Adaptation in Myanmar

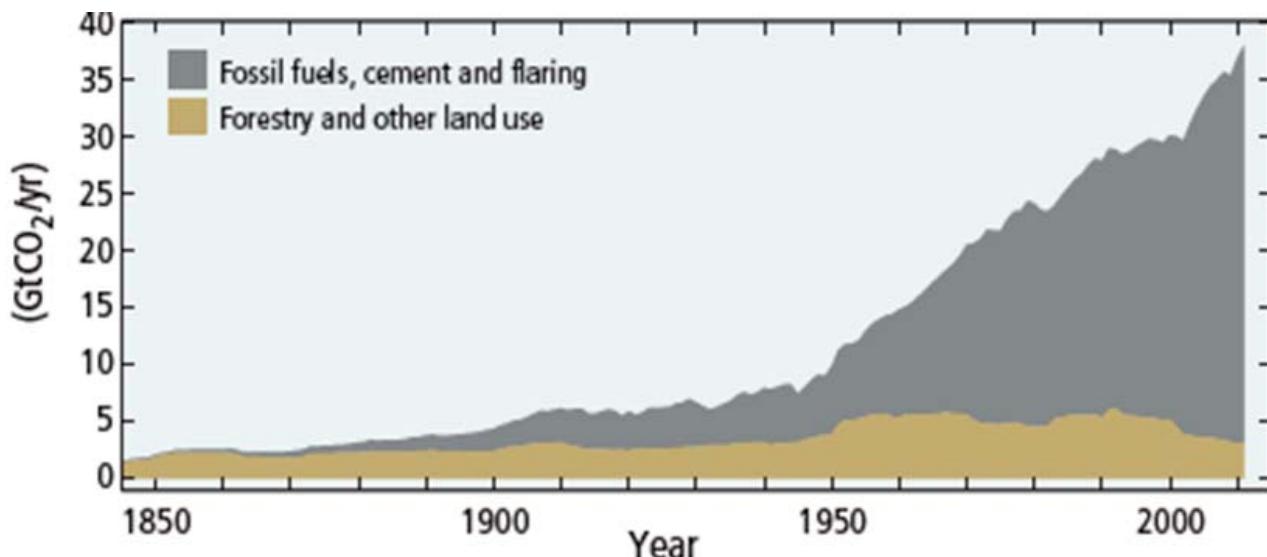


Figure 4 Global anthropogenic emissions of CO₂ (Source: IPCC, 2014)

It must be highlighted that these three greenhouse gases persist in the atmosphere over long periods of time – from a decade to centuries or longer. For instance, once emitted CO₂ can stay in the atmosphere for up to 200 years², CH₄ for about 12 years, and N₂O for about 114 years. Therefore, past and current emissions have a long-term influence on future climate. Consequently, even if we limit the emissions today, the long-lived greenhouse gases that are already accumulated in the atmosphere will continue to alter the climate on our planet.

Is Myanmar contributing to the global warming?

According to the National Greenhouse Gas Inventory 2000 (MNREC, 2012 (a)), as of 2000 Myanmar had negative CO₂ emissions because forests absorbed more CO₂ than it was emitted from human activities such as from industry, energy, transport and agriculture sectors (Figure 5). Main sources of greenhouse gas emissions were as summarized below.

- CO₂ in Myanmar is emitted from various sectors such as industrial production (especially cement production), transport and energy. Land-use change (particularly deforestation) is also a significant contributor.
- CH₄ is emitted mainly from the waste and agriculture sectors. Irrigated rice production and livestock have the highest share of CH₄ emissions, followed by land-use change and waste sectors.
- NO₂ emissions originate mainly from use of fertilizers and land-use change. Agricultural practices such as 'slash-and-burn' also emit NO₂ (and other gases such as CO₂).

Despite that Myanmar has low emission levels, with the expected future economic and population growth, emissions are likely to rise. This includes emissions from the energy-intensive sectors, as well as from agriculture and livestock production. Furthermore, sustainable forest management is crucial for maintaining low CO₂ emission levels in the country.

² The CO₂ lifetime cannot be defined because of the different rates of emission and removal.

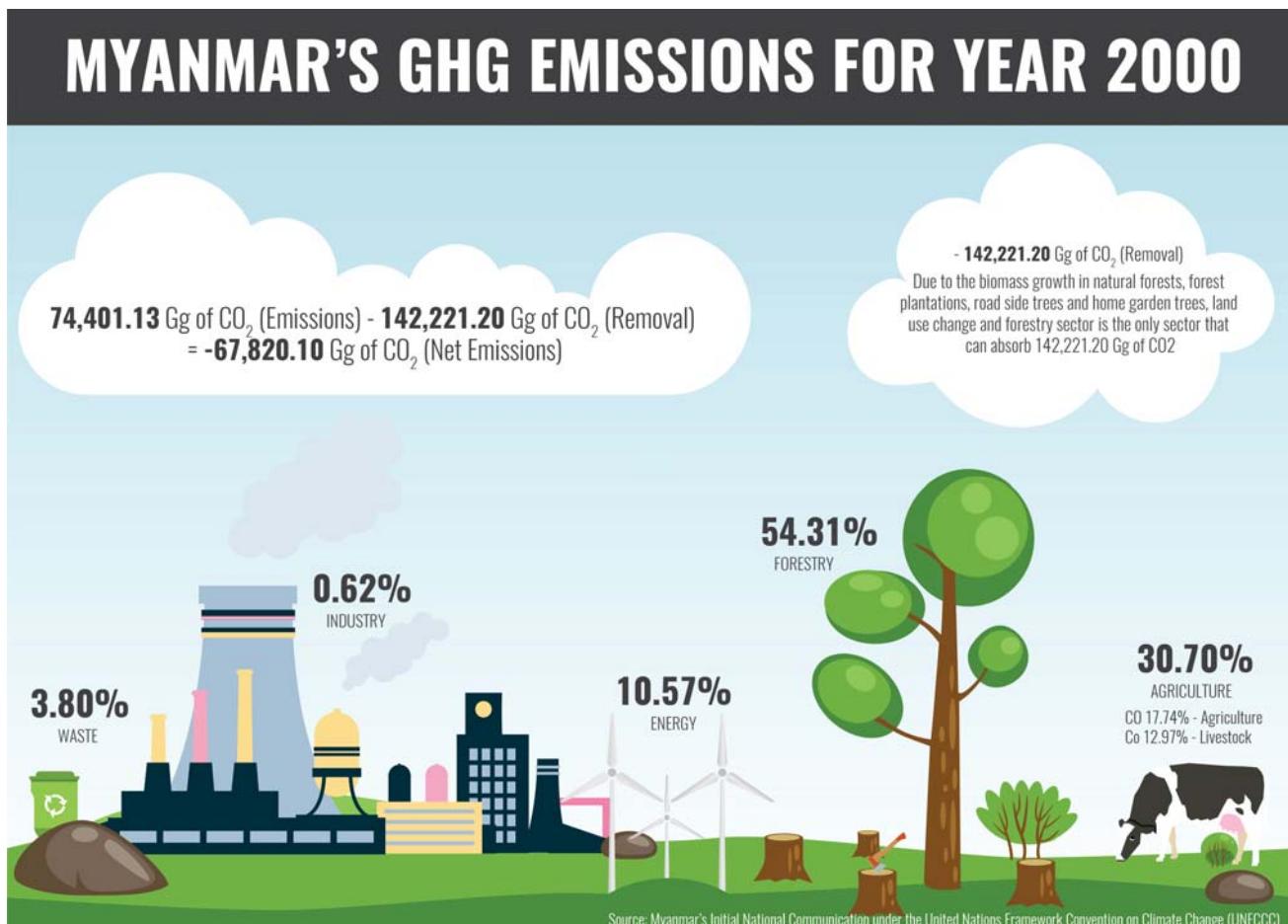


Figure 5 : Myanmar's greenhouse gas emissions for 2000
(Source: MCCA website, <http://myanmarccalliance.org>)

Where to find scientific evidence of climate change?

IPCC is a scientific body under the auspices of the United Nations. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to climate change and publishes reports. It does not conduct any research or monitor climate related data. The latest available reports are published in 2013-2014.

Observed climate changes

Warming of the climate system is evident from the observed increases in the average global air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level (Figure 6). The global average surface temperatures have increased by about 0.85°C from 1880 to 2012 (IPCC, 2014). This increase in temperatures has caused rapid changes within the global water cycle. Glaciers and polar ice sheets melt at an accelerated pace, contributing to rising sea levels. For instance, from 1901 to 2010 the global mean sea level rose by 0.19 m at a rate larger than the mean rate during the previous two millennia. As the ice melts, it also exposes dark ocean water, which absorbs more sunlight than ice. This in turn accelerates the process of warming of the sea and air surfaces, and hence, the melting of snow and ice. In addition, water evaporation increases with the rising temperatures, which contributes to the global warming since water vapor is a greenhouse gas.

Climate Change Adaptation in Myanmar

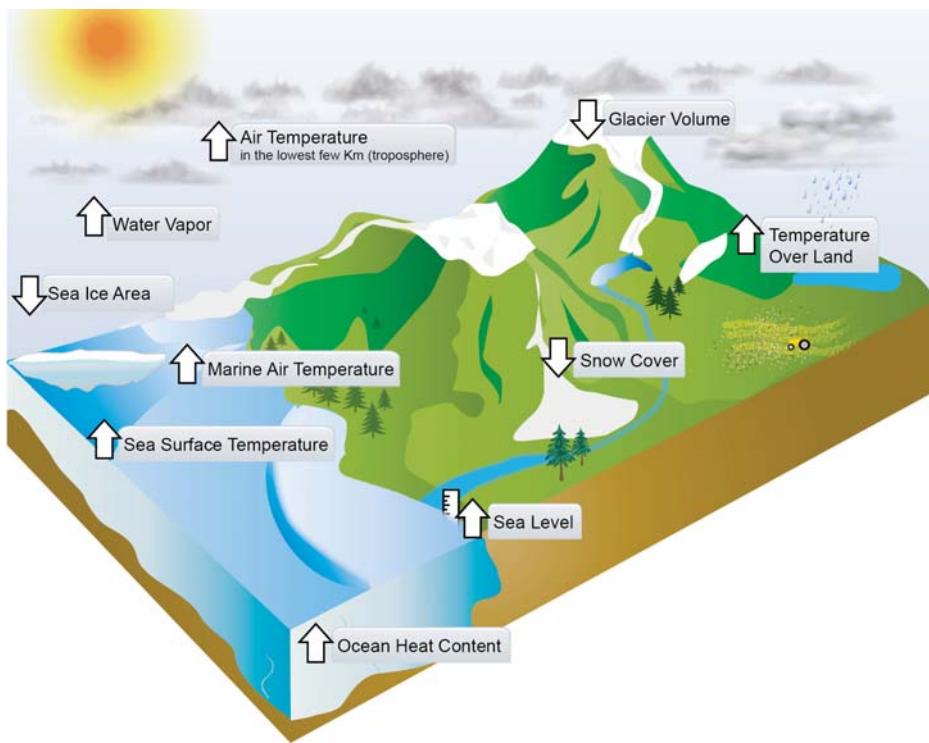


Figure 6 : Indicators of a Changing Climate (Source: IPCC, 2014)

Because of rising temperatures and sea level, weather events of all kinds are getting more extreme (Figure 7). For instance, the increased evaporation of water acts like fuel for storms, exacerbating extreme weather events, such as tropical storms and cyclones. Rising sea level causes coastal flooding events and coastal erosion. In arid areas, droughts and wildfires intensify. Number of cold days and nights decreases, while winter temperatures and precipitation become more extreme. Cities experience more frequent and extreme heat waves.

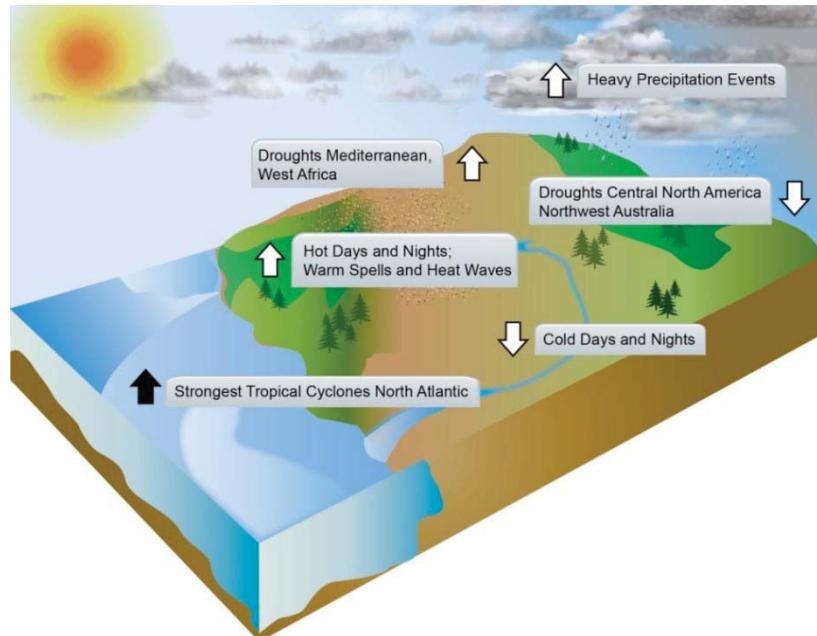


Figure 7 : Selected observed changes in climate extremes (Source: IPCC, 2014)

Global climate change projections

AR5 of IPCC summarizes the latest global and regional climate projections. The latter are used to describe possible future state of Earth's climate (e.g. in 2050 and 2100) based upon scenarios for Representative Concentration Pathways (RPCs) under assumptions concerning socio-economic and technological developments that may or may not be realized. IPCC has defined four RPCs scenarios, which capture selected possible states of the composition of the atmosphere (i.e. concentration of greenhouse gases and aerosols) and land cover up to 2100. These four RPCs are: two in which there is little to no coordinated action on reducing global emissions (worst case – RCP8.5 and best case – RCP6), and two in which there is a serious global action on climate change (worst case – RCP4.5 and best case – RCP 2.6).

All global climate change projections suggest that surface temperatures will rise further (Figure 8, a). Most scientists agree on the “threshold” of a 2°C increase in global average temperature on pre-industrial levels, above which humans and nature will not be able to cope with the consequences of climate change. However, climate projections warn that by 2100 we will reach the 2°C-threshold, which in turn will lead to a sea level rise of at least one meter. Furthermore, it is very likely that heat waves will occur more often and last longer.

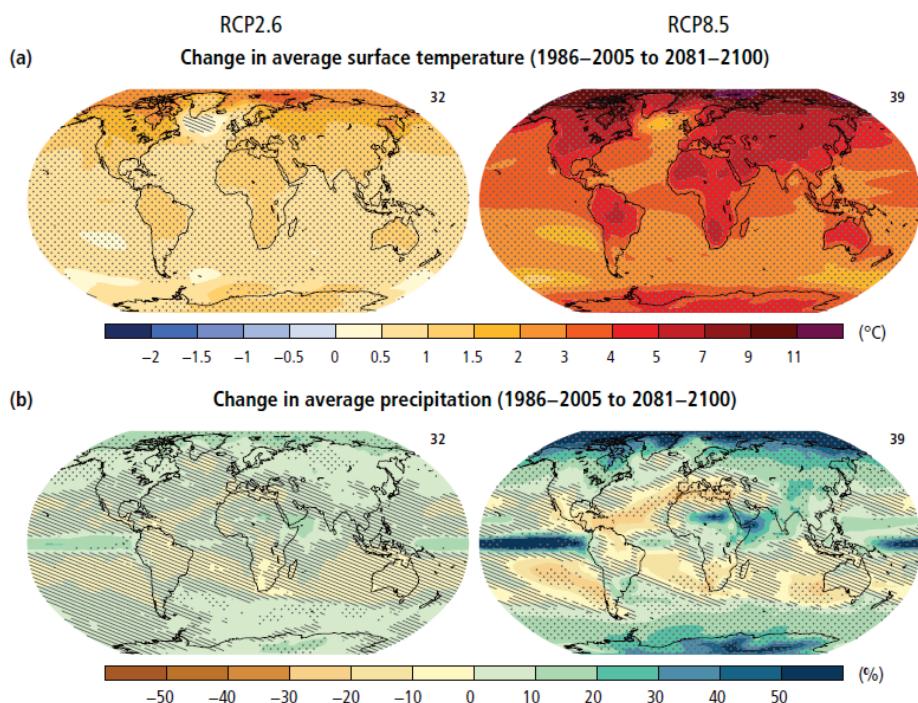


Figure 8 : Change in average surface temperature (a) and change in average precipitation (b) based on multi-model mean projections for 2081–2100 relative to 1986–2005 under the RCP2.6 (left) and RCP8.5 (right) scenarios (Source: IPCC, 2014)

Extreme precipitation events will become more intense and frequent in many regions, while other parts of our planet will experience severe droughts and consequent desertification (Figure 8, b). The oceans will continue to warm and acidify.

Climate is changing: what can we do?

- Countries, communities and individuals can adjust to already observed or expected climate and its effects with the objectives to moderate or avoid harm or exploit beneficial opportunities (IPCC, 2014). This process is known as adaptation to climate change.

There is a wide array of adaptation options, i.e. strategies and measures for CCA. These include structural, institutional and socio-economic actions to:

Climate Change Adaptation in Myanmar

- protect natural and human systems against the actual and anticipated harmful effects of climate change;
 - exploit any opportunities they may generate;
 - ensure the sustainability of investment and development interventions despite current climate risks and potentially increasingly difficult climatic conditions³.
 - Examples of structural measures include construction of shelters for heat waves and cyclones. Institutional adaptation to climate change suggests, for instance, building capacities of municipalities to plan and implement adaptation policies. Socio-economic adaptation measures could include income diversification of farmers, and improving access to insurance. Module 2 provides further knowledge on local adaptation options for Myanmar.
- Countries can reduce the sources or enhance the sinks of greenhouse gases emitted in the atmosphere, known as *mitigation of climate change* (IPCC, 2014). Mitigation encompasses a wide range of activities, from reducing deforestation while also planting trees, to switching to renewable energy sources and climate-smart agricultural practices.

It is important to highlight that:

- While through mitigation we can limit the global warming, the temperatures will continue to rise.
- Available adaptation options decrease with the increase in the global mean temperature.

Therefore, countries, communities and individuals should act today by mitigating climate change and adapting to its effects.

Global response to climate change and opportunities for Myanmar

In 1988, the United Nations General Assembly adopted Resolution on the “Protection of global climate for present and future generations of mankind” and IPCC was established with the objective to regularly review the scientific evidence of climate change and its impacts. More and more scientists and governments have realized that climate change poses significant risk to human development. This led to the adoption of the United Nations Framework Convention on Climate Change (UNFCCC) in 1992 (entered into force in 1994), which targets to achieve stabilization of atmospheric concentrations of greenhouse gases at levels that would prevent further human-induced global warming. Later, the threshold of a 2°C increase in global average temperature on pre-industrial levels has been determined. The Conference of the Parties, which is UNFCCC’s supreme decision-making body, has annual meetings on which signatory governments review the implementation of UNFCCC and take respective decisions.

Since UNFCCC is not a legally binding treaty, the Kyoto Protocol was adopted in 1997. The protocol seeks to frame specific measures towards reduction of the anthropogenic greenhouse gas emissions, whereas it shares the principles and objectives of UNFCCC. Entering into force in 2005, the Kyoto Protocol laid the foundations of international cooperation on reducing greenhouse gases in the atmosphere to slow-down the global warming process. The Protocol sets internationally binding emission reduction targets though commitments of signatory developed countries. The first commitment period expired in 2012, while the second commitment period ends in 2020.

After years of negotiations for a post-Kyoto Protocol regime, governments of countries signatory to UNFCCC made a step forward towards strengthening the global response to the increasing risk of irreversible climate change impacts. In the Conference of the Parties meeting in 2015, countries adopted the Paris Agreement, which serves as a roadmap to strengthen: (i) the global response to the threat of climate change by keeping the global temperature rise this century well below 1.5-2°C above pre-industrial levels; and (ii) the ability of countries to deal with the impacts of climate change. The Paris Agreement entered into force on 4 November 2016.

³ MCCA Dictionary (<http://myanmarccalliance.org/en/dictionary/>)

Under the current climate change regime framed by UNFCCC, vulnerable least developed countries such as Myanmar could receive support through various international mechanisms such as the Warsaw International Mechanism for Loss and Damage established in 2013. The mechanism is planned to address loss and damage associated with impacts of climate change, including extreme and slow-onset events in developing countries. It has the following key functions: (i) enhancing knowledge and understanding of comprehensive risk management approaches to address loss and damage associated with the adverse effects of climate change; (ii) strengthening dialogue, coordination, coherence and synergies among relevant stakeholders; (iii) enhancing action and support, including finance, technology and capacity-building. In addition, the Least Developed Countries Fund assists states in the preparation and implementation of their National Adaptation Programmes of Action (NAPAs).

Closing the session

QUIZ: 10 things you need to know about climate change

- 1** Understand the differences between: weather and climate; climate variability and climate change
- 2** Climate is changing and human activities significantly contribute to global warming
- 3** There are two ways to address climate change: mitigation and adaptation
- 4** By reducing emissions of greenhouse gases, we can limit the warming of the planet
- 5** Through mitigation we can limit the global warming, but the temperatures will continue to rise
- 6** A 2°C increase in global mean temperature and 1 meter rise in sea level are virtually certain
- 7** We will experience climate change through climate extremes
- 8** In future, climate change will have significant impact on all sectors
- 9** Adaptation options decrease with increasing global mean temperature
- 10** Countries, communities and individuals should act today by mitigating climate change and adapting to its effects

Session 1.3 : Observed and projected climate changes in Myanmar

Introduction to the session

Duration : 45 minutes

Training methods : Lecture, open discussions and quiz

Materials required : Projector, screen, PowerPoint slides and notes;

This session is focused on explaining the current climate patterns in regions of Myanmar, as well as expected future climate and related hazards. At the end of the session participants will be able to describe observed and projected climate changes at the national and sub-national levels.

Key points covered: present climate in Myanmar; observed climate changes; projections for future climate

Training content

Present climate in Myanmar

There are eight major physiographic regions in Myanmar: the Ayeyawady Delta, Central Dry Zone, Northern Hilly Region, Rakhine Coastal Region, Eastern Hilly Region, Southern Coastal Region, Yangon Deltaic Region, and Southern Interior Region. These regions form three main agroecological zones: i) Central Dry Zone; ii) Coastal Zone; and iii) Hilly Zone (Figure 11). The latter are used to describe climate variability and change at the sub-national level.

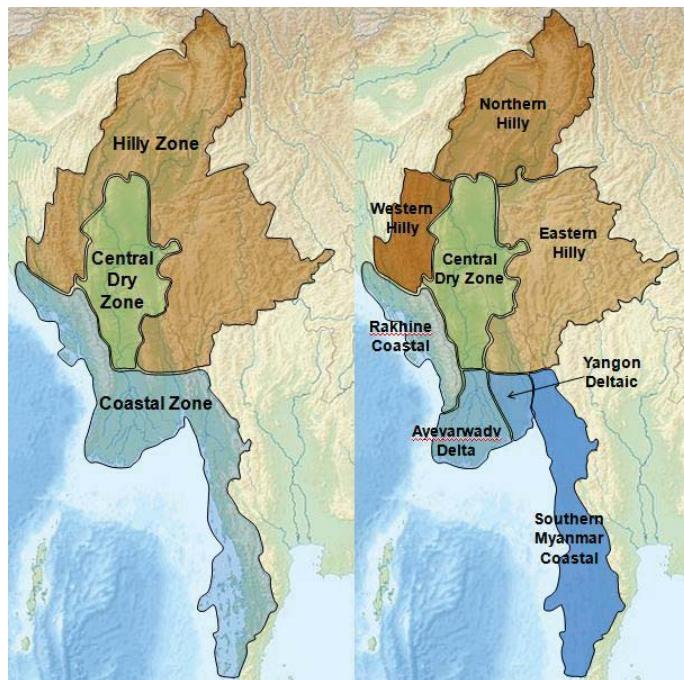


Figure 9 : Agroecological zones in Myanmar (left) and physiographic regions (right)
(Source: MNREC, 2012 (b))

The country's climate is tropical to subtropical monsoon with three seasons: (i) hot, dry inter-monsoonal (mid-February to mid-May); (ii) rainy southwest monsoon (mid-May to late October); and (iii) cool, relatively dry northeast monsoon (late October to mid-February) (MNREC, 2012(b)). Annual climate patterns, as well as seasonal temperatures and precipitation vary across the country, as summarized below (MNREC, 2012(b); Horton R. et al., 2016).

- *Coastal Zone* : The Yangon Deltaic Region has the highest mean annual temperature. The regions in the Coastal Zone receive the highest mean annual rainfall (2,500 – 5,500 mm) and are prone to flooding. Furthermore, the west coast experiences frequent tropical storms and cyclones during October-December and April-May periods.
- *Central Dry Zone* : Mean annual rainfall is the lowest in the Central Dry Zone (500-1000 mm per year) that is prone to extreme heat events and drought. Temperatures in this zone could reach 40-43°C during the hot dry season.
- *Hilly Zone* : The Northern Hilly Region has the lowest mean and maximum annual temperatures. The Eastern and Northern Hilly areas receive the lowest wet season precipitation, and both regions are exposed to heat waves, droughts and floods, as well as landslides.

Observed climate changes

According to recent estimations based upon data from 19 weather stations across Myanmar, average temperatures and precipitation have increased as described in detail below (Horton R. et al., 2016).



Figure 10 Trends in daily average (top row) and daily maximum (bottom row) average temperatures, 1981-2010 (Source: Horton R. et al., 2016)

Climate Change Adaptation in Myanmar

Temperatures : From 1981 to 2010 the national average daily temperatures increased at a rate of about 0.25°C per decade. In addition, the daily maximum temperatures rose by 0.4°C per decade over the same period. Inland territories have experienced more rapid temperatures increase in comparison to coastal areas (Figure 12).

Precipitation : Over the period 1981-2010 the total annual rainfall in coastal and inland regions increased by 4.5 per cent (157 mm) and 2.5 per cent (35 mm) per decade, respectively (Figure 13). Importantly, the Coastal Zone territories have experienced 17 per cent (85 mm) rise per decade in seasonal rainfall during the dry season (November-May).

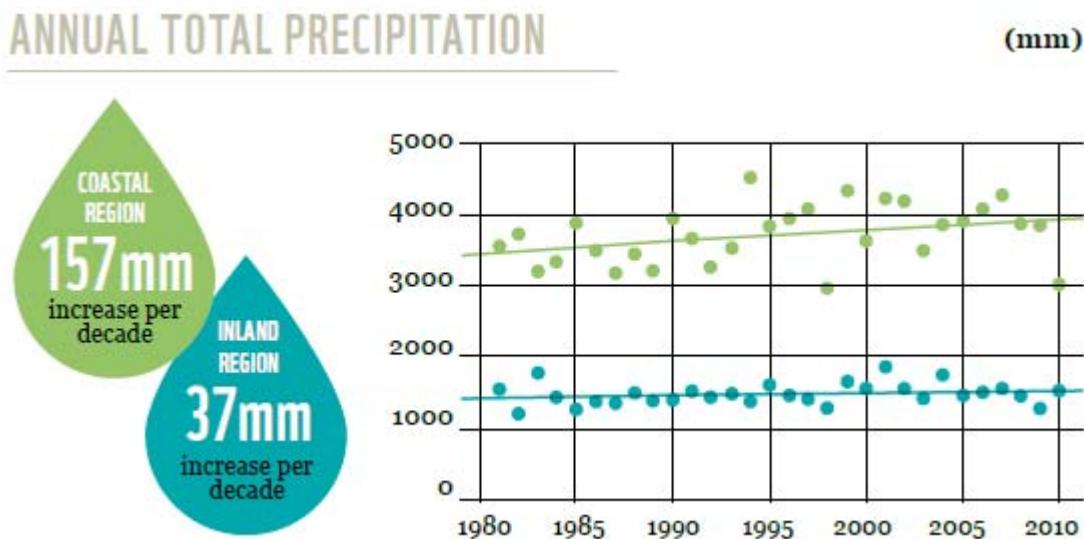


Figure 11 : Trends in total annual precipitation, 1981-2010 (Source: Horton R. et al., 2016)

Climate extremes/hazards : Myanmar has faced an increase in heat-related hazards since 1980s (MNREC, 2012 (b)). The most recent severe droughts occurred in 2010. Extreme high temperatures and heat waves affect mostly the Central Dry Zone. In addition, exposed to droughts are mainly the Eastern and Northern Hilly Regions, and the Central Dry areas.

Late onset and early withdrawal of the monsoon has been observed. Rainfall patterns have become more variable and unpredictable in terms of intensity and seasonality, e.g. shorter rainfall seasons combined with heavy rains. This has considerably increased the risk of flash and river flooding, and landslides. Catchment areas of major rivers in the Hilly regions and the Central Dry Zone, as well as the coastal areas are particularly exposed to floods caused by intense rainfall.

Storm surges and cyclones affect mostly the Rakhine Coastal State, Ayeyawady Delta and Mon State. Over the last two decades the county experienced more intense and frequent cyclones than before. For example, Nargis (May 2008) and Giri (2010) were the most devastating cyclones in the recent history of Myanmar.

Future climate⁴

Temperatures and heat extremes : In future, the average annual and daily maximum temperatures in Myanmar are projected to rise. Regions will face more often extreme hot days and heat waves (with temperatures above 38°C). Consequently, there is an increasing risk of forest and urban fires, especially in the Central Dry Zone.

⁴ Summarized from: Horton R. et al., 2016; MNREC, 2017; MNREC, 2012(b).

Inland areas are expected to warm at a higher rate than coastal territories. The Eastern and Northern Hilly Regions are likely to experience the highest increase in temperatures in the country. Estimations suggest that the national annual average temperatures could rise by 0.7-1.1°C during the period 2011-2040 and by 1.3-2.7°C from 2041 to 2070 (in comparison with the values for the 1980-2005 base period).

Precipitation and hydrological hazards : Predicting future rainfall patterns is difficult. Nevertheless, projections point out that in future Myanmar will experience more intense rainfall (relative to the 1980-2005 base period) particularly during the wet season. This in turn could exacerbate wet season flooding in some regions. Furthermore, seasonal rainfall patterns could become more erratic (e.g. periods of heavy rainfall followed by long-lasting dry spells).

Sea level rise and coastal hazards : By 2059 sea level in Myanmar may rise 41cm above the levels recorded between 2000 and 2004. By 2089 this rise could amount to 83 cm. Therefore, the country's low-lying coastal areas, such as Ayeyawady Delta, are at an increasing risk of frequent and severe coastal flooding (inundation) and storm surges from intense storms. Global climate change projections indicate that tropical cyclones will become stronger than they are today.

Note: Summary of observed and projected climate changes is provided in Annex I.

Closing the session

QUIZ: 5 things you need to know about the current and future climate changes in Myanmar

This quiz aims at assessing participants' ability to describe observed and projected climate changes at the national and sub-national levels. The course Facilitator should ensure that everyone could explain the climate change trends at the national level, as well as the current and future climate risks to their townships.

1

The temperatures across Myanmar are increasing, whereas this trend is more noticeable in inland regions than in coastal areas.

2

Rainfall patterns are changing: (i) rainfall events have become more intense, particularly in coastal areas; (ii) in future the rainfall will increase especially during the wet season; (iii) rainfall patterns are becoming more variable and unpredictable in terms of intensity and seasonality.

3

How is the climate in the Coastal Zone changing?

- Increasing temperatures
- Erratic rainfall, intense rains and flooding
- Sea level rise and coastal hazards (flooding, storm surges, strong winds)

4

How is the climate in the Central Dry Zone changing?

- Increasing temperatures and heat waves
- Droughts (and forest fires)
- Erratic rainfall, intense rains and flooding (along rivers)

5

How is the climate in the Hilly Zone changing?

- Increasing temperatures
- Droughts
- Erratic rainfall, intense rains and flooding, landslides

Session 1.4 : Key terms and concepts

Introduction to the session

- Duration** : 135 minutes /two blocks of 45 minutes lecture and one block of 45 minutes group activity/
- Training methods** : Lecture, open discussions, group activity
- Materials required** : Projector, screen, PowerPoint slides and notes; printed materials for group exercise, flip chart and markers

This session explains the key terms and concepts used in the fields of CCA and DRR. At the end of the session participants will be able to understand and define key terms and concepts including the difference between CCA and DRR. The definitions and concepts presented in this session are based upon and adapted from the glossaries of AR5 of IPCC, the Myanmar Climate Change Strategy and Action Plan 2016-2030, and the terminology used by RRD.

Key points covered: climate change impact, climate hazard, exposure, vulnerability, adaptive capacity, climate resilience, climate-resilient development, disaster and disaster risk, DRR, difference between CCA and DRR.

Training content

When talking about the threat of global warming, we should understand why the change in the climate affects us. The reason lies in the fact that we are exposed and vulnerable to the impacts of climate change and climate-related hazards. The probability of experiencing negative impacts of climate change is called climate risk. Risk results from the interaction of climate change and hazards, exposure and vulnerability. Adaptation and mitigation can reduce the risk (Figure 12).

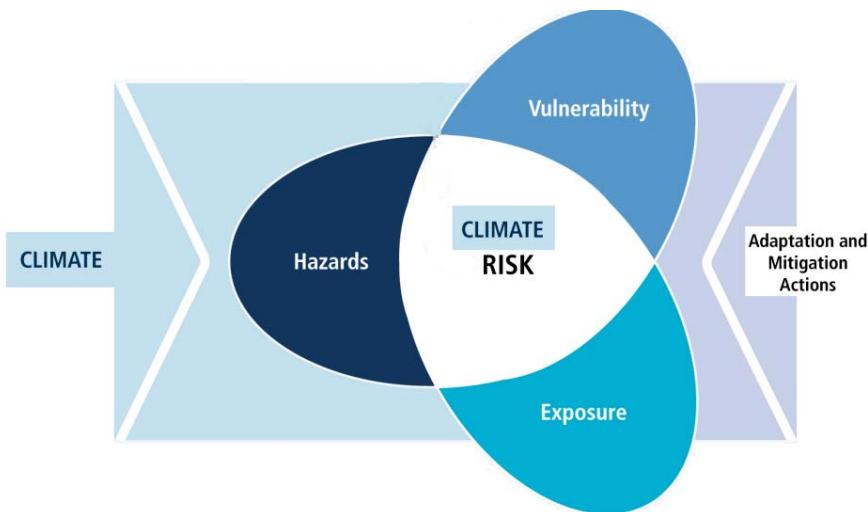


Figure 12 : The concept of climate change risk (Source: adapted from IPCC, 2014)

Climate change impacts are the effects of climate change (e.g. increasing temperatures and change in seasonal patterns) and extremes (e.g. heat waves, heavy rainfall, severe storms) on human systems and environment. The impacts of climate change include:

- Physical impacts – floods, droughts and sea level rise;
- Environmental – impacts on ecosystems such as loss of biodiversity, water scarcity, and land degradation;
- Impacts on human systems – socio-economic effects (e.g. loss of life and livelihood, food insecurity), and infrastructural consequences.

It must be noted that climate change could have positive impacts as well, such as more favourable agro-meteorological conditions in some regions. Nevertheless, the negatives of climate change surpass the positives. Figure 13 provides example of potential climate change impacts on township of Myanmar, categorized as primary impacts (i.e. those that are directly caused by climate change and/or climate hazard) and secondary impacts (i.e. those that have slow onset or occur due to primary impacts).

Climate hazard is any climate-related physical event (e.g. cyclone), trend (e.g. increasing temperatures in dry season) or impact (e.g. flood, sea level rise), which has the potential to cause loss of, and damage to, people, physical assets, provision of services, and ecosystems. Importantly, climate hazards can trigger secondary disasters such as landslides (caused by heavy rainfall), coastal erosion (caused by rising sea level) and forest fires (conditioned by heat waves). Most common hazards in Myanmar are flood, cyclone, drought and sea level rise, among others.

Hazards (and climate change impacts) can be divided into slow-onset (like drought and insect infestations), and rapid-onset (like floods) events.

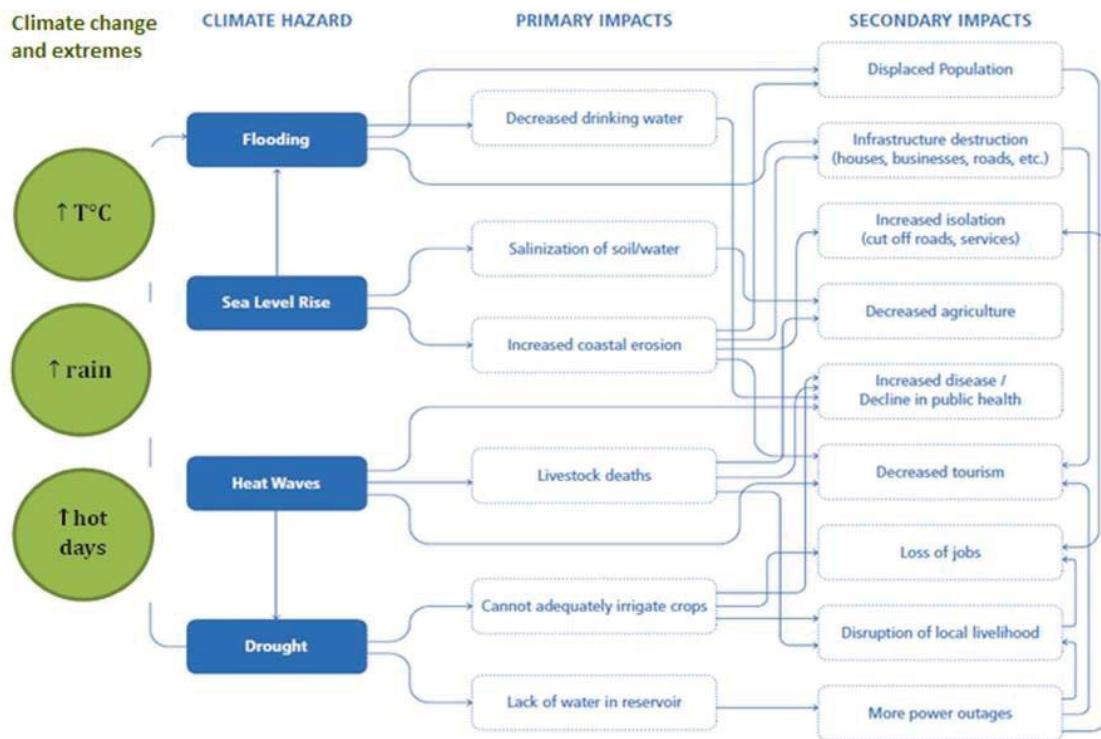


Figure 13 : Example of potential climate change impacts (source: UN-Habitat/MCCA)



(Photos: UN-Habitat/MCCA)

Exposure relate to the presence of human and environmental systems (including people, livelihoods, assets and infrastructure, ecosystems, etc.) in places that could be adversely affected by climate change and hazards. For example, exposed to climate change and hazards could be: the lives and health of people; natural resources that people use such as water, land, trees; houses and community assets; livestock and crops; public infrastructure and services such as electricity and water supply, schools and hospitals.

Vulnerability is the degree to which a system is susceptible to, or unable to cope with, the adverse effects of climate change, including climate variability and extremes. This notion is used to describe socio-economic, physical and environmental factors, which determine the sensitivity/susceptibility of a country, town, community or individual to the impact of climate change (e.g. change in seasonal patterns) and/or hazard (e.g. flood).

For example, socio-economic factors of vulnerability are poverty, low level of awareness on climate change, and dependence on climate-sensitive agricultural production. Land degradation and unsustainable natural resources management are environmental factors of vulnerability. For instance, cutting mangroves in populated coastal area increases the vulnerability of communities because mangroves help in reducing wind speed, flooding and coastal erosion. Physical vulnerability relates to the state of infrastructure and human settlements.

Countries and communities are more vulnerable when they have low adaptive capacity. The latter specifies their ability to adjust to climate change (including to climate variability and extremes) and moderate or cope with its potential negative impacts. Adaptive capacity also relates to the ability of people to take advantage of opportunities and benefits from climate change. For example, a longer growing season due to changing climate offers opportunity to farmers to increase their income. However, their adaptive capacity is often constrained by the limited access to knowledge and technology on how to increase their production under longer growing season conditions.

Adaptation to climate change (which was defined in the previous session) aims at reducing vulnerability and building climate resilience. Climate resilience is the ability of a system to (i) absorb stress and cope with climate change and hazards, including maintaining its basic structure, functions and adaptive capacity, and (ii) recover, adapt and transform in ways that improve its sustainability, leaving it better prepared for future climate change impacts. In this context, climate-resilient development of townships of Myanmar suggests development that ensures townships' ability to cope with current climate and its impact and to adapt to future climate change, by preserving development gains and minimising damages.

Case study: Household exposure and vulnerability to climate change and hazards

A family is living in Pakokku, close to Ayeyawady River. With the changing climate, the household experiences more hot days and heat waves than before. Furthermore, every year during the wet season the first floor of their house is flooded.

Exposure: high

The household is highly exposed to these climatic changes and hazards. Elderly family members suffer health problems because of heat waves. Floods (and sometimes prolonged dry periods) bring many additional risks to health such as diseases and decreased availability of drinking water. As well, the family uses the first floor of their house to produce slippers (flip flops) like many of their neighbours. However, they cannot make slippers during the annual flooding, and hence, the household loses its main source of income.

Vulnerability: high

The prime source of family income is the slippers business, which makes the family highly vulnerable during the wet season. The household has also limited access to water (primary groundwater) and electricity (with no access during floods). Securing food for the big family poses an additional challenge.

Adaptive capacity: low

The family lacks knowledge and awareness on climate change adaptation options. In addition, the limited access to financing for buying water storage container, and the lack of insurance opportunities for the family business, make the household even more vulnerable.

Disaster, disaster risk and DRR

With the changing climate, natural hazards are becoming more frequent, severe and intense than they were before. When hazards result in severe negative impacts on human systems (i.e. cause significant losses and damages), then we talk about disaster.

Similarly to climate risk, disaster risk is the probability of harmful consequences or expected losses resulting from the interaction between hazard, exposure and vulnerability. The more people are exposed and vulnerable to hazards, the more they are at risk of a disaster. Hence, pre-disaster policies and measures that reduce exposure, lessen vulnerability and increase capacities of communities can lower the risk of disaster. This response is known as DRR.



Climate Change Adaptation in Myanmar

Difference between CCA and DRR

The risk of climate change and climate-induced disasters necessitates an integrated approach to address these risks. Both, CCA and DRR, encompass a set of structural and non-structural measures that aim at reducing the vulnerability of communities, and hence there are many commonalities. However, CCA and DRR differ in scope and timeframe (Table 1). CCA focuses on climate-related disasters, while DRR deals with a wide range of risks (geological, hydro-meteorological, biological and technological hazards). In addition, the prime focus of DRR is on existing risks and vulnerabilities. In contrast, CCA goes beyond DRR measures, by addressing longer-term impacts of climate change (such as reduced water availability, soil salinization and loss of forests) and future vulnerabilities (e.g. expected high population growth and urbanization). Furthermore, CCA provides opportunity to reduce slow-onset hazards (e.g. droughts, impacts of sea level rise), which are often ignored in DRR plans.

For instance, DRR measure against coastal flooding, which affects communities living on a coastline could be building elevated houses designed to prevent damage from present disaster risks. Initiatives focused on CCA would likely consider projected changes along the coastline related to the expected future sea level rise, socio-economic development and environmental change in the area.

Table 1: Differences between CCA and DRR

CCA	DRR
focused on climate-related disasters	deals with a wide range of risks (geological, hydro-meteorological, biological and technological hazards)
addresses longer-term impacts of climate change and future vulnerabilities; recognizes that there are new risks (due to changes in current vulnerability and the frequency/magnitude of present hazards)	focused mainly on present risks and vulnerabilities
addresses slow-onset hazards (e.g. droughts, pests, impacts of sea level rise)	slow-onset hazards are often overlooked

Group work on key terms and concepts

Time needed:

- 5 minutes preparation
- 20 minutes for group work
- 20 minutes presentation of answers and questions from participants (if any)

Instructions:

- Divide participants into groups of 4-7 people and distribute the materials to each group (see Annex V.1).
- Explain to participants what the task is.
- Allow for 20 minutes group work. Ensure that participants clearly understand the task. Work together with each group for few minutes to get insight on participants' understanding of the terms and concepts. If something is not clear, repeat definitions and provide examples.
- Ask each group to present their findings and welcome questions if some of the terms are not well-understood by participants.

Task of each group: Based on a picture (material 1), which shows communities living along river, each group should identify and write down on a flip chart:

- 1) potential hazards and impacts of climate change on communities 1,2,3 and 4 using the provided sample (material 2). List no more than 3-4 potential impacts. Arrows must be drawn to show relations.
- 2) what makes the communities exposed and vulnerable to the identified climate changes and hazards, and what is their adaptive capacity, using the provided sample (material 3).

Additional readings

MNREC (2012). Myanmar Initial National Communication under UNFCCC. Ministry of Natural Resources and Environmental Conservation.

IPCC (2007). Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2013). Annex III: Glossary [Planton, S. (ed.)]. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2014). Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland.

MODULE 2

ADDRESSING CURRENT AND FUTURE IMPACTS OF CLIMATE CHANGE IN MYANMAR

Session 2.1 : Climate change vulnerability and policy response

Introduction to the session

Duration : 45 minutes /one block of 45 minutes/

Training methods : Lecture, open discussions, group activity

Materials required : Projector, screen, PowerPoint slides and notes

At the end of this session, participants should be able to:

- Explain what makes Myanmar vulnerable to climate change;
- Describe key disaster risks in Myanmar associated with climate change;
- List the key national policy documents that govern climate change in Myanmar;
- List the six priority areas identified for the country;
- Explain why actions are needed at a local level.

Key points covered: vulnerability of Myanmar to climate change, disaster risk profile of Myanmar (climate-related disasters), national climate change policy progress, strategic objectives of Myanmar Climate Change Strategy and Action Plan 2016-2030, local adaptation planning

Training content

Climate change vulnerability profile of Myanmar

According to the Global Climate Risk Index ranking (Kreft S. et al., 2015), Myanmar is the second-most vulnerable country to weather-related extreme events that occurred between 1995 and 2014 worldwide. Underlying factors of vulnerability relate to:

- High socio-economic dependence (employment, income, food security) on climate-sensitive sectors like agriculture;
- Large portion of the population lives in high-risk zones such as the Ayeyawady Delta, and the Central Dry Zone. These regions have the highest socio-economic vulnerability and exposure to climate change (Figure 14);
- Unsustainable natural resources utilization (e.g. deforestation, illegal fishing, unsustainable agricultural practices);
- High poverty, unemployment and migration rates;
- Human settlements/towns/cities are not prepared for the changing climate (e.g. inadequate urban planning and construction techniques, poor infrastructure);
- Low adaptive capacity characterized by limited access to knowledge, technology and financing.

Disaster risk profile of Myanmar (climate-related disasters)

Historically, Myanmar has been affected by various climate-related disasters including cyclones and storm surges, river and flash floods, landslides, droughts, heat waves and wildfires. For the period 1998-2007, the country experienced mostly fire-related disasters (71 per cent of all reported disasters), and numerous storm and flood events (MNREC, 2017). Over the last 10 years, two devastating cyclones, including Nargis (2008) and Giri (2010) claimed thousands of lives and affected more than 2.5 million people living along the coastline. The cost of floods and landslides accounted for 1.7 per cent of GDP in 2015-2016 alone. The severe dry spell in the summer of 2010 brought not only food and water insecurity, but also resulted in 260 heat-related deaths.

Future climatic change can cause: (i) increase of rapid-onset disasters such as tropical storms and cyclones, floods and storm surges; and (ii) more frequent and devastating slow-onset disasters like dry spells/droughts, diseases, loss of ecosystems, sea level rise and salinization in coastal areas, erosion.

Climate change policy progress in Myanmar

With the ratification of UNFCCC in 1994, the government of Myanmar became obliged to: (i) undertake inventory of greenhouse gas emissions from key sectors, makes projections for future emissions of greenhouse gases under different scenarios, and implement climate change mitigation policies; and (ii) assess risks posed by climate change and develop adaptation plans. The MNREC is the UNFCCC National Focal Point.

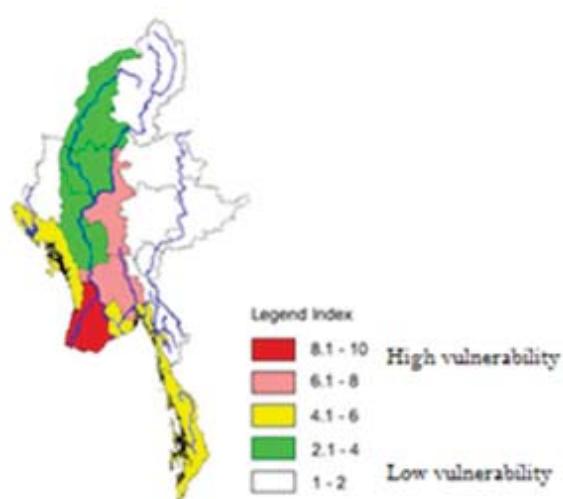


Figure 14 : Vulnerability indices for the States and Regions of Myanmar (Source: MNREC, 2012 (a))

Key advancements to date at a glance:

- In 2008 the country completed its National Greenhouse Gas Inventory for 2000 (set as a base year) in key sectors including energy, industrial processes and product use, agriculture, forestry and other land use, and waste. More specifically, the inventory provides estimates of national anthropogenic emissions by sources, and removals by sinks, for year 2000.
- The Initial National Communication under UNFCCC was published in 2012 (the Second National communication is under development).
- In 2012, Myanmar developed NAPA, which identifies the following eight priority sectors as most vulnerable to climate change: agriculture, early warning systems, forests, public health, water resources, the coastal zone, energy and industry, and biodiversity.
- MCCSAP 2016-2030 was developed in 2016 with the aim at supporting key actors at the national and local levels to respond to the challenges and benefit from opportunities associated with climate change.
- The Myanmar National Climate Change Policy, which will provide a long-term vision on climate change action is under development.

Sectoral strategic objectives

MCCSAP identifies six sectors most vulnerable to climate change, and lays out a strategy for mainstreaming CCA into sectoral policies. Sectoral strategic objectives are as follows:

- Climate-smart agriculture, fisheries and livestock for food security
- *Sectoral outcome:* Achieve climate-resilient productivity and climate-smart responses in the agriculture, fisheries and livestock sectors to support food security and livelihood strategies while also promoting resource-efficient and low-carbon practices.
- Sustainable management of natural resources for healthy ecosystem
- *Sectoral outcome:* Natural resource management that enhances the resilience of biodiversity and ecosystem services that support social and economic development and deliver carbon sequestration.
- Resilient and low-carbon energy, transport and industrial systems for sustainable growth
- *Sectoral outcome:* Climate-resilient and low-carbon energy, transport and industrial systems that support inclusive and sustainable development and economic growth.
- Resilient, inclusive and sustainable cities and towns where people can live and thrive
- *Sectoral outcome:* All township and city dwellers, including the most vulnerable, are safe from increased risks of rapid- and slow-onset natural disasters and live in sustainable, inclusive, low-carbon, climate-resilient towns.
- Climate risk management for people's health and well-being
- *Sectoral outcome:* Communities and economic sectors have the capacity to respond to and recover from climate-induced disasters, risks and health impacts and build a healthy society.
- Education, science and technology for a resilient society
- *Sectoral outcome:* Strengthen education, awareness and technological systems that foster a climate-responsive society and human capital to design and implement climate-resilient and low-carbon development solutions for inclusive and sustainable development.

Climate Change Adaptation in Myanmar

Local level action in response to climate change

The effects of climate change are experienced locally. Severity of impacts varies from region to region, from town to town, from community to community, depending on geo-physical and environmental characteristics, and socio-economic specifics. Therefore, local adaptation response is needed. It ensures proper consideration of: (i) local vulnerabilities (environmental, social, economic); and (ii) needs, capacities and resources of communities including local knowledge, skills and practices.

Local level impacts of climate change: the case studies of Pakokku and Labutta

This section presents selected findings from the climate change impact analyses conducted in Labutta and Pakokku Townships – both located in the most vulnerable regions of Myanmar. The objective is to improve participants' understanding on local level impacts of climate on multiple sectors and on communities.

The climate change impact assessments presented below are based upon: (i) projected changes in the townships' climate for the year 2050 and related hazards; and (ii) analysis of secondary data and consultations with communities.

Case study 1: Labutta Township (delta area)⁵

Projections alarm that by 2050 the average temperature and number of hot days in Labutta will increase, and sea level will rise. Furthermore, fewer rainy days but more intense rainfall than the current averages are expected. In addition, Labutta will likely be increasingly affected by coastal flooding, storm surges and cyclones (Figure 15).

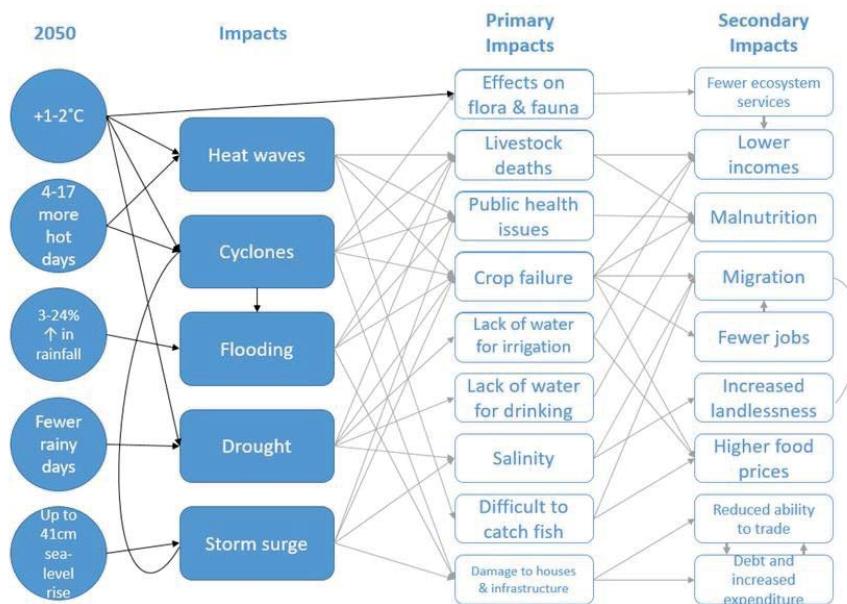


Figure 15 Pathways to potential climate change impact in Labutta Township (2050)

Primary and secondary impacts include loss of ecosystem services, crop failure and food insecurity, water scarcity, unemployment and limitations to income generating opportunities. *It should be noted that some impacts could be a result of the combined effects of climate change and multiple hazards.*

Spatial analysis reveals that the capacity of the population to benefit from agriculture will be significantly reduced by 2050 due to climate stress and decline in ecosystem services including freshwater, soil and crops (Figure 16).

⁵ Summarized from: Fee, L., et al., 2017(a) (forthcoming)

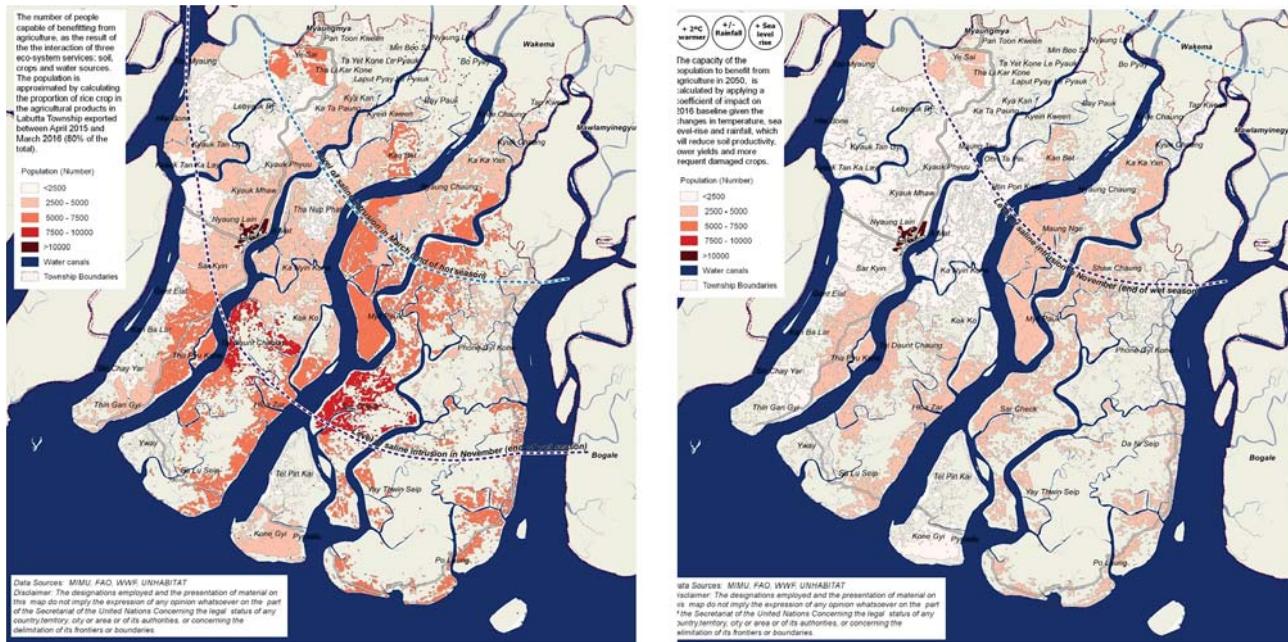


Figure 16 : Capacity of the population to benefit from agriculture in 2016 (left) and 2050 (right)

Figures 17 and 18 show the enormous impact of climate change on the capacity of people to access transportation services and freshwater for drinking in 2050. Some coastal areas will become permanently or partially inundated. Boat and road transportation infrastructure could be affected by disasters. In addition, water scarcity, floods and salinization of freshwater resources (rivers, streams, groundwater) will limit the access to drinking water.

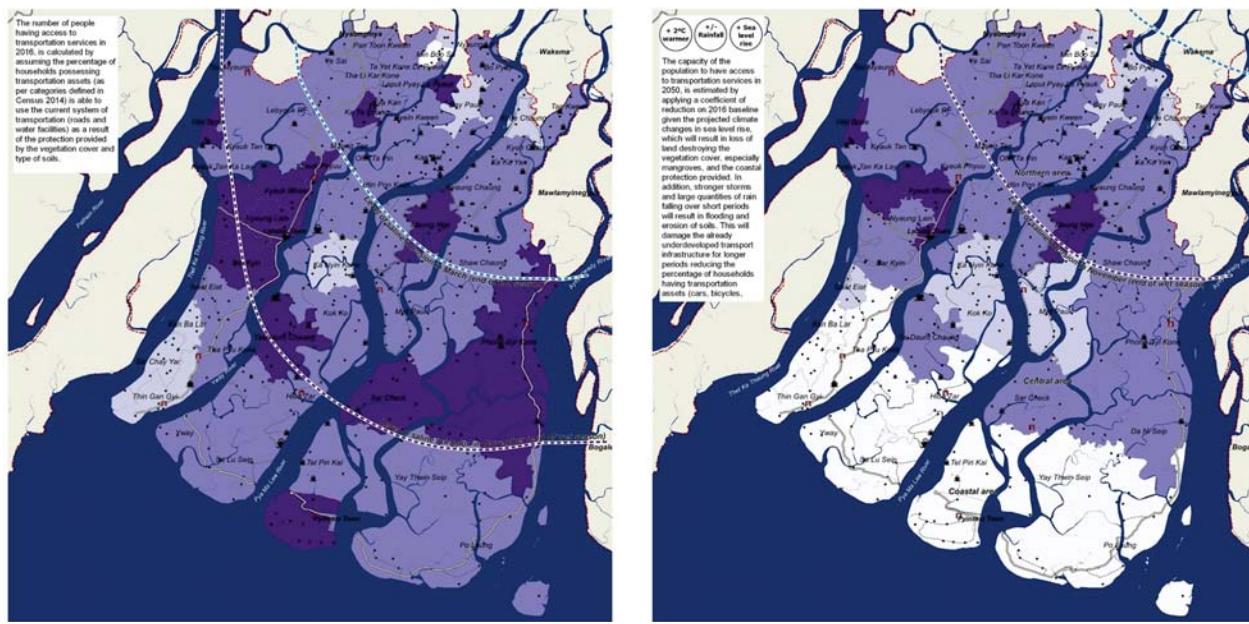


Figure 17 : Capacity of the population to access transportation services in 2016 (left) and 2050⁶

6 The dark purple colour (left) shows areas where 50-100 per cent of the households have access to transportation services as of 2016, while the white areas (right) suggest low access (0-25 per cent of the households) in 2050.

Climate Change Adaptation in Myanmar

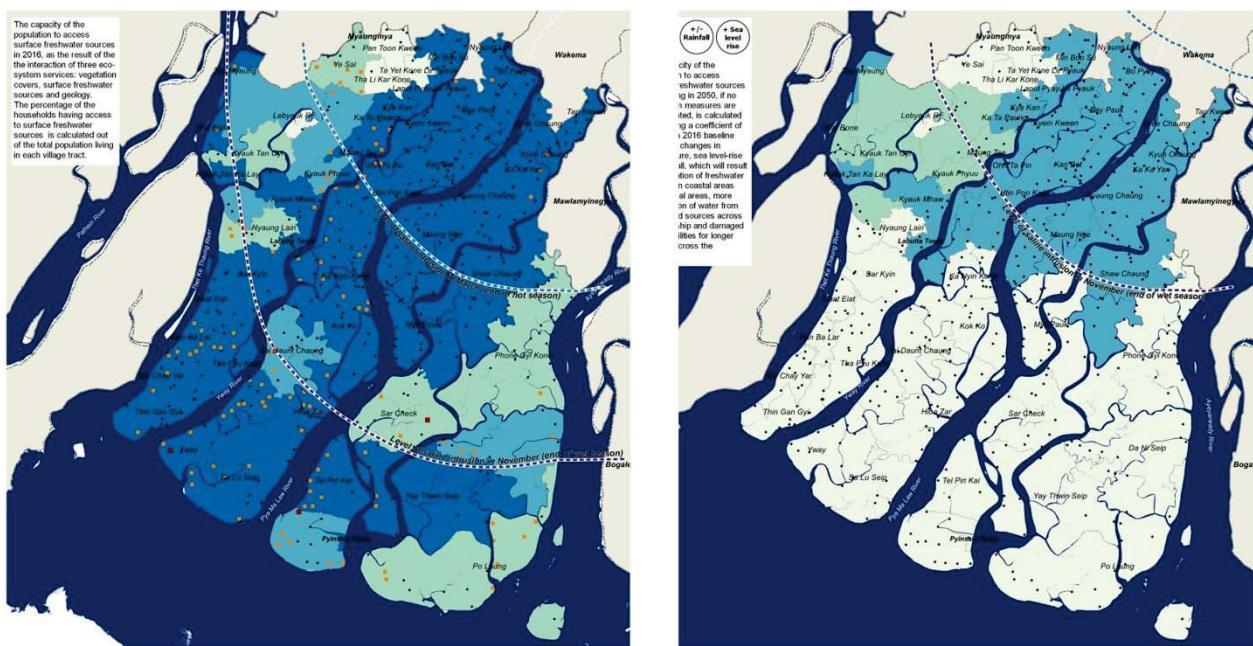


Figure 18 : Capacity of the population to access freshwater for drinking in 2016 (left) and 2050 (right)⁷

Case study 2: Pakokku Township (the Central Dry Zone)⁸

Pakokku township will likely experience increase in the average annual temperatures and warming in all seasons. The number of hot days is expected to increase as well, particularly during the hot season (March-May). Wet season is expected to bring more intense rains. Consequently, the risk of hazards such as heat waves, erosion, drought and floods will increase (Figure 19). Like in the case study of Labutta, primary and secondary impacts include declines in the well-being of people dependent on ecosystem services, agriculture sector losses and malnutrition, water scarcity, unemployment and migration, lower economic growth.

Agriculture sector (especially rain-fed production) will be challenged by increased heat and drought stress, and lengthening dry season (and shorter growing season). Communities along the riverbank will face more floods, landslides and intense run-off and consequent damages to crops and infrastructure for irrigation. Their overall capacity to benefit from agriculture will decline (Figure 20). Furthermore, fewer people will have access to drinking water (Figure 21). Both freshwater availability and quality will decline, which would likely lead to a health decline and increased migration. Floods and erosion processes could damage water storage and distribution facilities/infrastructure.

⁷ The dark blue colour (left) shows areas where 75-100 per cent of the population have access to drinking water as of 2016, while the white areas (right) suggest water access in the range of 0-25 per cent in 2050.

⁸ Summarized from: Fee, L., et al., 2017(a) (*forthcoming*)

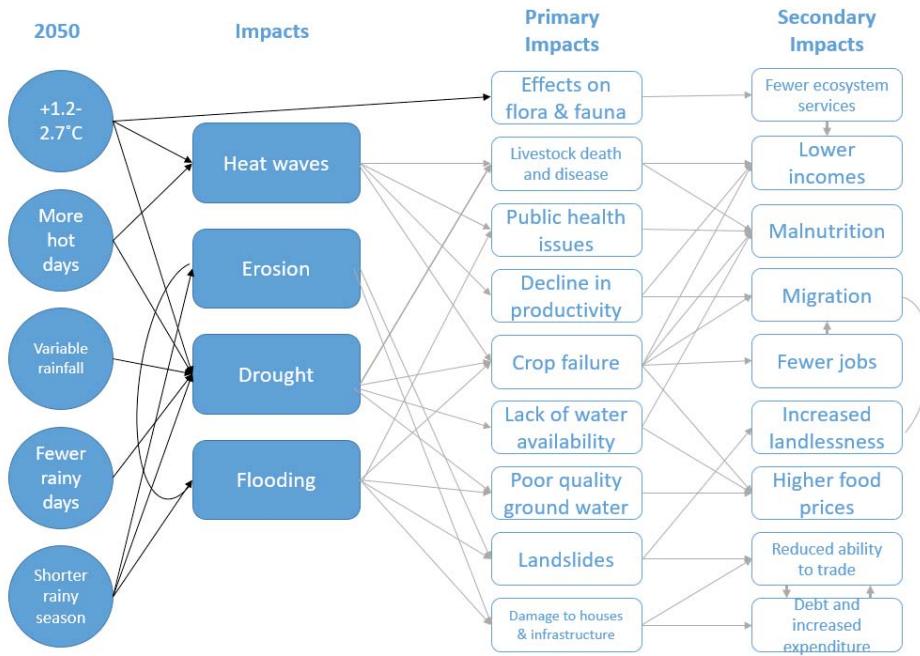


Figure 19 : Pathways to potential climate change impact in Pakokku Township (2050)

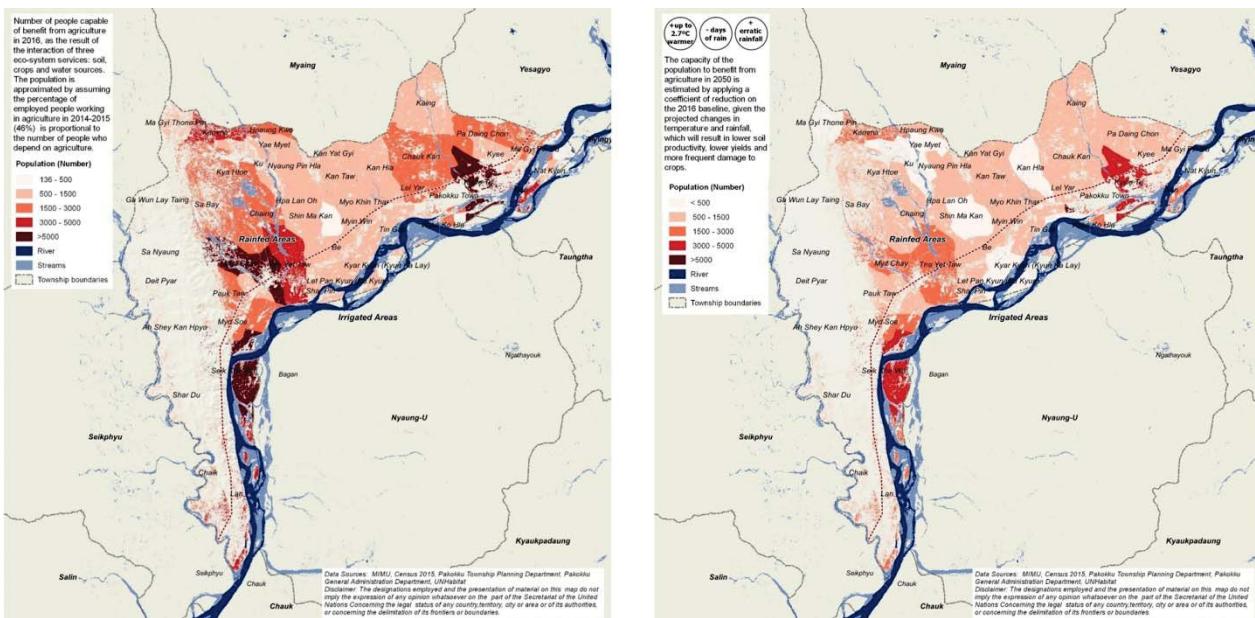


Figure 20 : Capacity of the population to benefit from agriculture in 2016 (left) and 2050 (right)

Climate Change Adaptation in Myanmar

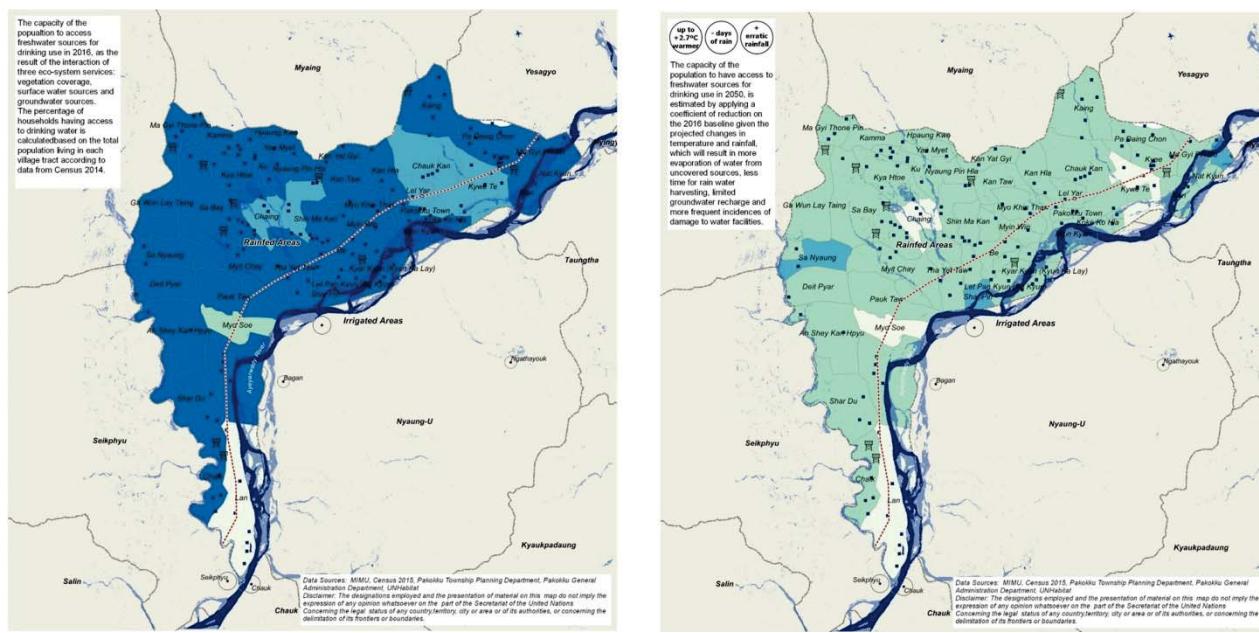


Figure 21: Capacity of the population to access freshwater for drinking in 2016 (left) and 2050 (right)⁹

9 The dark blue colour (left) shows that 75-100% of the population have access to water, while the light blue colour (right) points to access to water in the range of 25-50%.

Session 2.2 : Impacts and adaptation: ecosystems

Introduction to the session

Duration	: 180 minutes /three blocks of 45 minutes lecture and one block of 45 minutes group activity/
Training methods	: Lecture, open discussions, group activity
Materials required	: Projector, screen, PowerPoint slides and notes; printed materials for group activity, flip chart and markers, colorful sticky notes/cards (three different colors, e.g. green, orange, blue)

At the end of this session, participants should be able to:

- Describe various ecosystem services
- Explain potential climate change impacts on ecosystems and their services
- Define local level actions for building resilience of ecosystems

Key points covered: ecosystem services, impact of climate change on ecosystems, human factors of environmental change, ecosystem-based adaptation

Note: Refer to Annex II for a broad list of potential climate change impacts on key sectors. A long list of adaptation options, developed in compliance with the sectoral objectives postulated in the national climate change policy framework, is provided in Annex III. The following sections contain selected examples from these lists.

Training content

Defining ecosystem services

Ecosystems provide people with numerous benefits called ecosystem services, which could be categorized as follows:

- *Provisioning services* are all products obtained from ecosystems such as food, freshwater and raw materials. For instance, people depend on lakes and rivers for water and fish, while forests are vital source of wood and food for many communities. Nature also provides people with traditional and commercial medicinal plants/raw materials (e.g. 'Thanaka' in Myanmar).
- *Regulating services* are related to the ability of ecosystems to regulate natural processes such as water, air and soil quality control, erosion prevention and moderation of extreme events. For example, trees in urban areas provide shade in hot days and improve the air quality, while mangroves can protect communities from hazards by reducing wind speed, flooding and coastal erosion. Forests remove CO₂, prevent soil erosion and landslides, and reduce the flow of water during floods. Wetlands can filter waste water (e.g. human and animal waste) and absorb floodwaters.
- *Cultural services* refer to non-material benefits such as using the nature for tourism, ecotourism and sports, and cultural and spiritual activities.
- *Supporting services* are those benefits related to natural processes that support and maintain all other services (e.g. soil formation, providing nutrition and habitat for species).

Climate Change Adaptation in Myanmar

For example, Mangroves provide the following key ecosystem services:

- Regulating: coastal protection, carbon storage
- Supporting: habitat for fish and other species
- Provisioning: source of timber and fuelwood
- Cultural: tourism

Impacts of climate change on ecosystems

Climate change will affect ecosystems and communities depending on ecosystem services. Below are discussed some of the major impacts of climate change on vital ecosystems¹⁰.

Agricultural land, soils and crops

Climate change will exacerbate soil erosion process in some areas. For instance, strong winds can remove the surface layer of dry soils, and heavy rains/floods can increase waterlogging and washing away of top soil and nutrients.

Intense rainfall and floods increase the risk of landslides in the Hilly Zone. Degradation of agricultural land due to landslides has already been observed in this zone.

Rising sea levels could lead to a loss of agricultural land and/or land productivity. In future, parts of inhabited and productive coastal areas could become permanently inundated, while others could be affected by intrusion of salt water into groundwater systems, soil salinization and coastal erosion processes. For example, stakeholder consultation revealed that every two years in the Ayeyawady Delta around two million hectares of land are flooded and more than three million hectares are moderately inundated.

Increasing temperatures and change in soil moisture could have negative impacts on strategic crops such as rice and wheat yields, and could increase the risk of significant losses due to plant pests and diseases. Furthermore, droughts will increase the demand for irrigation that could put water and land resources under growing pressure.

Inland water resources

Climate change will affect the hydrological cycle in many regions across the country. Intense rains increase the risk of river floods and flash floods, which could result in contamination of water resources. Intense floods coupled with prolonged drought periods will alter river flow and consequently the recharge of groundwater resources. Freshwater biodiversity could also be affected by the expected change in climate conditions. For example, during prolonged dry and hot periods, Inle Lake is becoming shallower, whereas negative impacts have been already observed not only on lake's biodiversity and ecosystems, but also on local tourism.

Marine and coastal ecosystems

Sea level rise could lead to salinization of land and water (groundwater and surface) resources in low-lying coastal areas and the Ayeyawady Delta Region. Myanmar can also experience a loss in marine biodiversity caused by a change in the seawater chemical composition (oceanic warming and acidification), which is one of the major impacts of climate change. For example, coral reefs are vital habitat for fish and shellfish. However, increasing seawater temperatures affect the corals and hence alter the living environment of numerous marine species. Furthermore, coastal erosion, sea level rise and more intense and frequent tropical storms will likely lead to deterioration of mangrove ecosystems in some areas.

10 Summarized from: Horton R. et al., 2016; MNREC, 2017; MNREC, 2012(b).



Forests and mountain ecosystems

Forests cover about 45 per cent of the country's territory. However, climate change is likely to affect the distribution, composition and health of forests in Myanmar. Droughts and high temperatures will increase the risk of forest fires, particularly on the Central Dry Zone and the northern regions. The Central Dry Zone may experience desertification and loss of tree/plant species. Forests may suffer increasing incidences of plant pests and diseases, while hilly areas will likely face a growing number of landslides.

Human activities as drivers of environmental change

Climate change is not the only driver of environmental change in Myanmar. Recent and expected economic growth, coupled with increasing migration to urban areas will lead to a significant stress on environment and natural resources. Industries such as manufacturing and coal production are also expected to expand. Deforestation and unsustainable agricultural practices will further exacerbate the environmental degradation in the country and increase the national greenhouse gas emission levels. For example, more than 70 per cent of the population depends directly or indirectly on forest resources, especially in rural areas. Forestry sector contributes one per cent to GDP, and 10 per cent to Myanmar's exports revenues (MNREC, 2017).

Electricity generation and transportation sectors are also growing and unsustainable development of these sectors could have significant environmental consequences. At present, only about 30 per cent of the population has access to grid electricity. Hydroelectric power generates about 75 per cent of county's electricity, natural gas 20 per cent, coal 3 per cent and 2 per cent are supplied from other sources (MEPE, 2013). According to the National Energy Policy (2014), the electricity sector should expand rapidly by 2030, with a target of achieving 60 per cent electrification by 2025–2026. Furthermore, with the urban population growth and the expected expansion of the transport sector, the use of fossil fuels will increase sharply. For comparison, the greenhouse gas emissions from the transport sector accounted for 20 per cent of the total emissions in 2002 (MNREC, 2012 (a)).

What is ecosystem-based adaptation?

Ecosystem-based adaptation comprises actions related to the conservation, sustainable management and restoration of natural ecosystems to help people adapt to climate change. In general, ecosystem-based adaptation is integrated into broader adaptation and development strategies.

Climate Change Adaptation in Myanmar

Long-term consequences of climate change on ecosystems in Myanmar

In brief, the long-term consequences of climate change on ecosystems in Myanmar include:

- Reduced agricultural productivity in a long-term;
- Increasing human pressure on water, land and forest resources, e.g. for agriculture and energy production;
- Lower productivity of ecosystems, resulting in e.g. decline of yield in agriculture and fisheries, or water for drinking;
- Desertification (caused by, for instance, intense rains following lengthier dry periods, which increases run-off rate and soil erosion; deforestation and heat stress);
- Loss of tree and plant species, and in turn reduced carbon storage and sequestration capacity of the country.

Response to climate change: enhancing the resilience of ecosystems in Myanmar

Numerous local measures have the potential to enhance the resilience of ecosystems, and hence, to enable people to adapt to the impacts of climate change. These measures are known as ecosystem-based adaptation.

Ecosystem-based adaptation actions could be categorized into restoration and conservation activities, enforcement of laws/regulations, improved management of natural resources, community-based approaches, and capacity-building and awareness-raising initiatives. Examples of CCA are provided below.

Agroecological systems

In the face of climate change, townships and communities should achieve climate-resilient productivity and promote resource-efficient practices through improved water, soil and crop management in agriculture and livestock sectors.

For instance, practices to improve soil, water and crop productivity include:

- Promoting conservation tillage techniques to preserve moisture and soil nutrient content.
- Introducing inter-cropping, crop-rotation techniques (e.g. in fields used for cash crops), and promoting crop diversification (i.e. adding new/alternative crops to agricultural production) to improve soil quality, and increase food and income opportunities.
- Introducing new crop varieties resistant to environmental stress (e.g. flood-, drought-, heat- and salt-tolerant varieties; varieties with a shorter growing cycle) and improving the access of farmers to seeds. Trainings on crop management should also be provided.
- Introducing alternate wetting and drying irrigation for rice (i.e. periodic drying and re-flooding of a rice field), which saves water and reduces greenhouse gas emissions while maintaining yields.
- Improving water management through building climate-resilient infrastructure.
- Establishing water user groups/committees and providing trainings on water management and maintenance of water infrastructure.

Marine and coastal ecosystems

Mangroves provide protection against climate hazards, as well as breeding and feeding grounds for fish and other aquatic species. Therefore, they should be protected through:

- Promoting community-based resource management projects to rehabilitate and manage mangrove forests.

- Raising awareness of local communities to prevent over-extraction, and promote sustainable forest use.
- Working with cooperatives for conservation.
- Increasing patrols and enforcing laws/regulations to prevent cutting of mangroves.

Marine ecosystems and fish stock should also be protected and utilized in a sustainable manner:

- Increase patrols and enforce laws/regulations to illegal fishing and practices such as chemical and electric shock fishing, as well as overharvesting of fish stocks. Work with communities to develop fishing calendars.
- Expand protected zones along the coast.

Inland water resources

To restore and sustain ecosystem balance in lakes, rivers, wetlands and groundwater reservoirs, local governments can:

- Enhance vegetation cover (e.g. trees plantation)
- Control of pollution from agriculture (e.g. by encouraging use of organic fertilizers)
- Raise awareness of local communities
- Enforce laws/regulations
- Ensure efficient water use for domestic, agricultural and industrial purposes.

For example, riverbank vegetation cover (trees, shrubs) reduces riverbank erosion, controls run-off, and protects communities against upstream flow regime variation, flash floods, sea level rise and storm surge. In addition, townships can implement small-scale watershed management projects which aim at reducing risks (e.g. improved storm water run-off from agricultural and urban areas) and enhancing health of ecosystems (such as reducing pollution from various human activities, and preventing deforestation and soil erosion).

Forests

To protect and rehabilitate forests, townships can:

- Adopt community-based forestry, provide trainings and raise awareness of communities.
- Increase electrification rate/provide alternative sources of energy such as solar power cook stoves, to reduce reliance on firewood and charcoal for energy generation.
- Conserve and adopt practices on sustainable management of forests
- Enforce laws/regulations against illegal commercial logging, conversion of forests to agricultural land, and unsustainable practices such as slash and burning.

Hilly zones and dryland

Townships located in hilly lands can reduce the erosion and landslide risk by undertaking various mitigating measures such as shrubs/trees plantation, construction of drainage systems, and sustainable use of land for agriculture.

With the changing climate, dryland ecosystems are at risk of frequent wildfires. Therefore, townships should strengthen their capacities to prevent such hazards, and to restore affected areas. Furthermore, in dry areas, afforestation is important measure for preventing soil erosion, provide canopy cover, recharge groundwater, and prevent flash floods and excessive sedimentation.

Environmental monitoring for improved resilience

Townships should strengthen their capacities for monitoring of key environmental indicators such as climate parameters, soil properties, erosion and sedimentation, water quality, vegetation cover, health of forests. Specific actions could be focused on strengthening technical and human capacities (e.g. delivering computers and creating monitoring database, trainings, etc.), and engaging academia in developing environmental monitoring systems and conducting policy-oriented research.

Group work on climate change impacts and adaptation at a local level: ecosystems

Time needed: 45 minutes

Objective of this group activity: to identify climate change impacts on **ecosystems** in a selected township, and propose options for adaptation.

Instructions:

- Divide participants into groups of 5-8 people. Each group should choose one township (familiar to participants) located in the Central Dry Zone, Coastal Zone or Hilly Zone. If possible, each group should include people with different backgrounds such as socio-economic (e.g. rural development, industries, education, etc.), urban planning and infrastructure, and agriculture and environment.
- Distribute materials to each group and explain to participants what the task is. (refer to Annex V.2)
- Allow for 30-35 minutes group work. Ensure that participants clearly understand the task. Work together with each group to get insight on participants' understanding of the task. If something is not clear, repeat information from the lecture and provide examples.
- Ask each group to present findings and encourage open discussion on key issues (10-15 minutes).

Session 2.3 : Impacts and adaptation: socio-economic systems

Introduction to the session

Duration	: 180 minutes /three blocks of 45 minutes lecture and one block of 45 minutes group activity/
Training methods	: Lecture, open discussions, group activity
Materials required	: Projector, screen, PowerPoint slides and notes; printed materials for group activity, flip chart and markers, colorful sticky notes/cards (three different colors, e.g. green, orange, blue)

At the end of this session, participants should be able to:

- Explain potential climate change impacts on economy and society, including
 - Agriculture sector and food security
 - Industries and businesses
 - Employment and migration
 - Health and education
 - Vulnerable groups of the society
- Define local level actions for building socio-economic resilience.

Key points covered: climate change impacts on economy and society (agriculture, fisheries and livestock sectors and food security; manufacturing sector and businesses; employment and migration; health, education and vulnerable groups), response to climate change within socio-economic sectors

Note: Refer to Annex II for a broad list of potential climate change impacts on key sectors. A long list of adaptation options, developed in compliance with the sectoral objectives postulated in the national climate change policy framework, is provided in Annex III. The following sections contain selected examples from these lists.

Training content

Agriculture and food security

■ Agriculture, fisheries and livestock sectors: impacts and vulnerability

Myanmar's agriculture, fisheries and livestock sectors, which are highly exposed to climate change and hazards, play a key role in supporting economic growth, local livelihoods and food security. Quick facts :¹¹

- Agriculture is the second-largest contributor to GDP (28.6 per cent in 2015–2016), employs 61 per cent of the labour-force and is characterized by small-scale production. Almost two-thirds of the total cultivated land is used for rice production, and one-third for beans and pulses (both leading export crops); other crops include oilseeds, vegetables, chilies, maize, cotton, rubber, sugarcane and tropical fruit.

¹¹ Summarized from MNREC, 2017.

Climate Change Adaptation in Myanmar

- *Fishery* sector constitutes about ten per cent of GDP and employs more than five per cent of the total population. The dominating small-scale fisheries are prime source of food and income for millions of people.
- *Livestock*, primarily backyard cattle, buffalo, pigs and poultry, supports households' economic and food security.

Climate change impacts and vulnerability :¹²

- Increasing temperatures and erratic rainfall, combined with frequent occurrence of droughts and floods, will result in a loss of agricultural productivity, including short-term crop failures and livestock losses, and long-term production declines:
 - Droughts and change in rainfall patterns will affect the rice production, 80 per cent of which is rain-fed;
 - Seeds/grain stocks could be affected by hazards such as floods and diseases, which would threaten the food security of entire communities.
 - Extreme events (droughts and floods) could cause livestock feed and water shortages, as well as animal diseases, and consequent loss of livestock. This suggests loss of essential food and income security asset for many rural households. For example, in the Central Dry Zone, past extreme drought and flooding events have caused a feed shortage for livestock, and as a result, the local productivity has declined.
 - Disastrous events (severe flooding/storms/strong winds) often lead to a direct loss of crops and livestock. Furthermore, the increasing number of coastal hazards has already brought enormous agricultural losses in low-lying coastal areas, including the Ayeyawady Delta. For instance, in 2008 Cyclone Nargis damaged four million hectares of rice (57 per cent of the country's total annual production), while floods in 2011 that affected Ayeyawady, Bago, Mon and Rakhine regions resulted in loss of around 1.7 million tons of rice.
- Climate change and hazards have also high impact on fisheries. Cyclones and tropical storms along the country's coastline, and floods along major rivers, often lead to loss of fishing boats and assets, and damages to infrastructure. After such disasters, affected fishermen lose their income for weeks.

Coastal ecosystems (such as mangroves, coral reefs and sea-grass beds), which provide vital breeding and feeding habitats for fish, shrimp and other species, are deteriorating due to sea level rise, cyclones/tropical storms and storm surges, and human activities (e.g. cutting mangroves). The coastal environmental degradation is leading to a decline in fish and shrimp stocks and has a consequent negative impact on human livelihoods.
- Climate change impacts on agriculture will have significant socio-economic consequences and affect the poorest strata of the population, because:
 - 70 per cent of the population lives in rural areas (as of 2014), and about 75 per cent of rural people depend on small-scale agriculture (crops, livestock, fishing);
 - 85 per cent of those living below the poverty line reside in rural areas;
 - the decline in production of crops such as rice and livestock could lead to an increase in food prices and threaten the food security of low-income families.

12 Summarized from: MNREC, 2017; MNREC, 2012(b).

□ Agriculture and food security: local response

Key strategic objective of the country is to achieve food security under climate change and hazards. It is widely accepted that food security has three components: food availability (e.g. sufficient quantity of domestic food production, or imported goods), food utilization (e.g. adequate diet, clean water) and food access (e.g. access to markets and food-provisioning resources, food prices and affordability). Hence, local CCA policies and measures should address a wide range of climate change vulnerabilities, including:

- Sustaining the agricultural production through promotion of sustainable fisheries, climate-resilient farming systems, climate-smart farming/cropping practices and technologies, and improved access of farmers to financing and insurance.
- Sustaining/developing industries related to processing of agricultural output, which can provide income and jobs.
- Improved storage and stockpiling of food/seeds.
- Increased awareness and capacities of local producers/farmers.
- Promoting community-run climate monitoring and disaster early warning to protect crops and livestock.
- Improved marketing of agricultural production and sustained access to markets under the challenges of climate change.
- Sustained access to food-provisioning resources (ecosystem services).
- Food prices stability and affordability.
- Improved nutritional value and quality of food and water for drinking.

Industries and businesses

■ Climate change impacts on industries and businesses

- Food and agriculture processing industries could be affected by the impacts of climate change on crops and livestock production, as well as on fisheries. For example, an increase in prices of agricultural input/raw materials due to climate changes could lead to an increase in prices of processed products and make industrial production less competitive. In a long term, this could result in increased unemployment in the sector and impede the economic development.
- Small-scale household production (e.g. textile) could be affected by seasonal floods and other hazards.
- Climate change could also affect the health of employees and, hence, their productivity.

■ Local response to climate change: Industries and businesses

Local governments should promote inclusion of climate change in business planning of local companies, and low-carbon and climate-resilient production. They should also support small- and medium-size producers to diversify local economy and job market. Examples of local CCA options in the private sector include:

- Raising awareness on climate change and risks in the private sector. Particularly large- and medium-size companies should be well-informed on potential climatic threats and encouraged to develop long-term business plans with climate change and disaster risk considerations.
- Improving access to loans, insurance, skills development (trainings) especially of small and medium enterprises. For example, townships can support establishment of microfinance organizations to provide loans for small and medium enterprises, which would diversify local economy.

Employment and migration

■ Climate change impacts on employment and migration

As mentioned previously, the impacts of climate change on agriculture and industrial production could limit the demand for employees in these sectors. As well, connectivity between settlements in many parts of the country could be impacted by hazards such as permanent or temporary inundation of coastal areas, or damages to road infrastructure, which in turn would reduce the access of people to work opportunities.

Another key social issue related to climate change impacts is the migration to urban areas¹³. In 2014, the urban population of Myanmar was around 14.9 million (almost 30 per cent of the total population estimated at 51.48 million). The country has 330 towns and cities. Yangon and Mandalay are the major urban and economic centres where 20 per cent of the urban population lives. However, it is expected that by 2030 the urban population will grow rapidly¹⁴ – a trend driven by various factors such as economic growth and industrialisation, rural poverty and unemployment. However, long-term slow-onset climatic changes such as increased temperature and changing rainfall patterns can also drive rural-urban migration. For example, statistical trends and local consultations in Pakokku Township (the Central Dry Zone) revealed that changes in climate observed over the last 20 years affected crop productivity and conditioned migration to urban areas (and in some cases to other countries).

The projected rapid urbanization will increase the risks posed by climate change in cities/towns. High migration flows often lead to establishment of informal settlements located in the most hazardous zones of towns and cities. The socio-economic vulnerability of people residing in such settlements could be further deepened by the adverse effects of climate change such as poverty and limited access to basic services. The long-term social consequences of climate change include further migration to urban centres, displaced population from coastal areas, and increased poverty. In addition, conflicts over land and diminishing water resources could emerge.

■ Local response to climate change: Employment and migration

In response to the risks described above, townships can: (i) strengthen social protection mechanisms to secure jobs and income so that people have capacity to respond to the impacts of climate change and disasters; (ii) plan for new risks conditioned by climate change (e.g. heat and water stress, migration and rapid urbanization, sea level rise and displacements). Among the measures that can be implemented at a local level are:

- Provision of vocational and skills training, and apprenticeships, such as carpentry, business development or computer skills;
- Introducing job guarantee schemes to provide employment for people during times like floods or after cyclones when other work may not be available;
- Local adaptation planning and integration of climate change considerations in local budgets.

Health, education and vulnerable groups

■ Climate change impacts on human health, children and other vulnerable groups

Health. Climate change and hazards pose significant risk to human health. Potential impacts of future climate include increase of vector-borne diseases and heat-related illnesses, injuries and malnutrition, among others (see Table 2). For example, floods and storm surges contaminate drinking water and can result in diarrheal diseases; exposure to flood waters can cause various skin diseases; floodwater provides a breeding ground for mosquitos and hence increases the risk of malaria. Furthermore, many communities will experience decreased access to safe water due to droughts or salinization of freshwater resources, which will increase dehydration risks and further exacerbate diarrheal diseases.

13 The following two paragraphs are summarized from: MNREC, 2017; MNREC, 2012(b).

14 Estimations suggest that by 2030 the share of urban population will be in the range 36.9-50 per cent.

Table 2 : Potential climate change impacts on public health¹⁵

Health concerns	Climate change impacts
Temperature-related morbidity	Heat and cold-related illness Cardiovascular system illness
Vector-borne diseases	Malaria, filarial, dengue and other pathogens carried by mosquitoes, ticks and vectors
Health impacts of extreme weather	Diarrhoea, cholera and poisoning caused by biological and chemical contaminants in water Damaged public health infrastructure due to cyclones Injuries and illness Social and mental stress from disaster and displacement
Health impacts of food and water insecurity	Malnutrition and hunger, especially in children

In urban areas, population will be exposed to heat waves, decreased access to water and nutrition, increasing pollution levels. For instance, frequent water shortages may result in higher prices for basic services in Yangon and Mandalay. Impacts on agricultural production would affect food supply and prices as well, threatening the food security of low-income households.

In addition, with rising temperatures and heat stress, large cities such as Yangon and Mandalay could be exposed to urban heat island effect, which brings negative impacts on human health such as heat-related illnesses.

What is urban heat island effect?

Urban heat island effect is a condition in which an urban area significantly warmer than its surrounding areas, due to human activities. Most significant determinant is the land surface of urban areas, because roads and buildings absorb more solar radiation than green areas. Emission of greenhouse gases and lack of vegetation exacerbate the effects of this phenomenon.

Vulnerable groups. Certain social groups such as poor people, women, children and elderly, as well as disabled and ill members of the society, are more at risk of climate change and hazards than others. Therefore, policy-makers should be aware of the specific needs and vulnerabilities of such high-risk groups. Poor people are more vulnerable to the impacts of climate change as previously highlighted. In addition, pregnant women, children, elderly and sick people face bigger climate change risk to health and life. For instance, heat waves affect mostly old people and pregnant women. Furthermore, during rapid-onset disasters such as floods or storms, these social groups are most at risk as they have limited mobility. As well, in many areas, people will be strongly affected by a lack of clean water for drinking and sanitation (e.g. due to salinization of water resources or droughts) that can lead to serious health risks especially for pregnant women and children.

Children will be affected by the impacts of climate change in many other ways. Climate change will affect income of poor households, especially in rural areas. This will limit the ability of families to cover school costs and provide their children with nutritious and healthy food. Furthermore, extreme heat, floods and storms are already affecting the access of children to education and threatening their health.



¹⁵ Extracted from MNREC, 2017.

Climate Change Adaptation in Myanmar

■ Local response to climate change: Health, education and society

Adequate public health care. Townships can strengthen local level capacities for response to existing and new climate-related health risks, and ensure that most at-risk communities have access to health care. This can be achieved through:

- Improving access to health services, sanitation and hygiene. For example, decentralized health care facilities could be established to ensure that all people have adequate access to healthcare, especially those living in rural areas and exposed to various climate hazards. Townships should also construct or upgrade water and sanitation infrastructure, and ensure that all citizens have access to basic services.
- Increasing awareness of climate change and health to enable people to undertake actions by themselves that prevent injury and disease due to climate hazards. Awareness-raising can be achieved through community level workshops, schools and radio broadcasts, distribution of brochures, among others.

Social inclusion. Local governments should place social inclusion at the core of CCA planning and implementation, though:

- Developing inclusive CCA plans, i.e. considering the needs of children, and poor and marginalized groups, and ensuring their participation in policy planning and implementation;
- Tailoring CCA measures, which target vulnerable groups such as low-income families, people with disabilities and women heads of households;
- Seeking participation of children and youth in developing community action plans and establishing volunteer groups.

Public awareness. Townships can foster public awareness to create climate-informed and responsive society through various channels such as:

- Conduct radio and television broadcasts with relevant information. Engage (local) media such as newspapers to reflect various climate change events and activities organized in townships to raise awareness.
- Organize trainings and workshops on CCA targeting communities and civil society groups; and work with volunteers to reach communities and vulnerable groups, and build their capacities through trainings.
- Create appealing brochures, games, short videos and materials that share climate change messages. Engage communities and representatives of vulnerable groups in developing awareness-raising materials such as women, people with disabilities and children.
- Use school and community events to raise awareness. For example, include climate change among the topics of open day events organized by local schools.

Group work on climate change impacts and adaptation at a local level: socio-economic systems

Time needed: 45 minutes

Objective of this group activity: to identify climate change impacts on **socio-economic systems** in a selected township, and propose options for adaptation.

Instructions: continuation of the previous session group activity.

Session 2.4 : Impacts and adaptation: infrastructure and human settlements

Introduction to the session

- Duration** : 180 minutes /three blocks of 45 minutes lecture and one block of 45 minutes group activity/
- Training methods** : Lecture, open discussions, group activity
- Materials required** : Projector, screen, PowerPoint slides and notes; printed materials for group activity, flip chart and markers, colorful sticky notes/cards (three different colors, e.g. green, orange, blue)

At the end of this session, participants should be able to:

- Explain potential climate change impacts on infrastructure and human settlements;
- Define local level actions for building climate-resilient infrastructure and cities.

Key points covered: climate change impacts on energy, transport, industrial and water infrastructure; climate change impacts on human settlements (housing, basic services), options for building resilient infrastructure and human settlements

Note: Refer to Annex II for a broad list of potential climate change impacts on key sectors. A long list of adaptation options, developed in compliance with the sectoral objectives postulated in the national climate change policy framework, is provided in Annex III. The following sections contain selected examples from these lists.

Training content

Impacts of climate change on infrastructure and human settlements

Urban infrastructure and services

Overall, human settlements, towns and cities in Myanmar are not well prepared for the changing climate¹⁶. Urban vulnerabilities emerge from inadequate urban planning and construction techniques, poor infrastructure (e.g. lack of drainage, water and sanitation systems) and undeveloped basic services sector, limited financial capacity of townships. Furthermore, the projected rapid urbanization (already discussed in session 2.3) will increase the risks posed by climate change in large urban centres.

In this context, without adaptation, the impacts of climate change on cities and towns in Myanmar could be enormous. Many urban areas could suffer significant loss and damage of assets, houses and urban infrastructure as result of climate hazards (e.g. from floods or coastal hazards). Coastal towns such as Bogalay (Ayeyawady Region) may need to be relocated or redesigned because of sea level rise. Permanent inundation in coastal areas could force displacement of whole communities. Growing water and energy demand will surpass the available resources in future.

16 Summarized from: MNREC, 2017; MNREC, 2012(b).

Energy, transport and industrial facilities and infrastructure

The energy, transport and industry sectors are of strategic importance for the development and structural transformation of Myanmar's economy. As previously discussed, the expected economic growth could have high impact on environment and ecosystem services, including increased greenhouse gas emissions and reduced carbon sinks. Meanwhile, the three sectors (energy, transport, industry) will experience the negative consequences of climate change and challenge the economic growth of the country. These are summarized below¹⁷.

Impacts on the production and distribution of electric power

- Heat waves and increasing number of hot days could increase the energy demand, while prolonged droughts and change in river flows due to erratic rainfall will likely affect hydropower energy supply (potential energy price increases), which currently represents 75 per cent of country's electricity consumption.
- Intense rains and increasing number of flood events could trigger large-scale erosion processes, leading to siltation and sedimentation of waterways and dams. This could result in reduced water storage capacity of dams, structural damages, and increased maintenance and operational costs.
- Storms, floods and other rapid-onset hazards could potentially damage energy infrastructure (e.g. dams, electricity grid, gas pipelines, solar panels of households, etc.).

Impacts on transport infrastructure and connectivity

- Road infrastructure (including bridges) could be damaged from cyclones, severe storms, floods and landslides.
- Sea level rise would affect connectivity in coastal areas and the Delta. For instance, permanent inundation in some low-lying areas in the Delta Zone will limit the road transport, and make canoe transportation more dangerous than before due to high waves and larger distances.
- River transportation could be challenged by river floods and even droughts in some areas. This would affect communities depending on river (or lake) for trade and transportation.

Overall, climate related hazards will likely affect the access to transportation services and connectivity of communities. Secondary impacts include reduced access to basic services (hospitals, schools) and work place (hence less job opportunities); and reduced access of small producers to markets and consequent loss of income; among others.

Impacts on industrial facilities and infrastructure

Manufacturing and industrial facilities can be destroyed or damaged by hazardous events. If affected by a big disaster, large industrial infrastructure/facilities containing hazardous materials (e.g. oil and gas) may trigger secondary disasters such as toxic spillage.

Water and irrigation infrastructure

As mentioned earlier, climate-related disasters will bring damages to dams, water facilities and infrastructure. Irrigation and drainage networks of agricultural fields could also be damaged by various climate hazards. Water scarcity is already felt in many places throughout the country. In the meantime, economic and population growth, and urbanization trends are already leading to an increase in the demand for drinking water and water for irrigation. This means that there is an urgent need of rehabilitation and modernization of existing water infrastructure and facilities including to improve water-use efficiency and build disaster-resilient water supply systems.

¹⁷ Summarized from: MNREC, 2017.

Local response to climate change: Infrastructure and human settlements

To build resilient infrastructure and human settlements, local governments can (among others):

- Ensure that climate change resilience and low-carbon city development are defining elements of urban planning. Specific actions include:
 - Introduce green infrastructure in cities/towns (e.g. parks, trees), which can reduce urban heat island effects and control the air quality.
 - Improve basic infrastructure and services (e.g. drainage systems, waste management). For example, management of infrastructure at the township and community levels could be improved through awareness-raising and capacity-building activities. In addition, communities could be trained on maintenance of community infrastructure. This is essential because future climate and population changes will create pressure.
 - Create climate resilient urban transport system through improved spatial and transport planning.
 - Promote climate and disaster resilient housing, and improve access of communities to resilient infrastructure and services. Some examples on how to do that:
- Promote disaster and climate resilient housing, including building design and techniques. Townships can provide training to communities on construction and maintenance, so that residents can build their homes themselves using local materials.
 - Improve water infrastructure and services such as water capture and storage. This entails: conducting a study on water availability in different locations to determine interventions (e.g. upgrading ponds or building new facilities); (ii) working with communities to plan and install the new facilities; and (iii) training local people on maintenance.
 - In the face of changing climate and increasing deforestation, townships can diversify energy sources by constructing new/renovate existing mini-scale hydropower dams, and promoting renewable energy to communities (community kitchens, cook stoves and solar panels). These activities can improve energy access in rural areas, while preserving forests. In addition, trainings on maintenance should be provided.
 - Conduct study on willingness to pay for retrofitting that would inform township administration on how much people are willing and able to pay to upgrade their houses. This could help to plan for additional support needed for at-risk communities.
- Adapt transport systems to heightened risks of disasters from new climatic conditions, and improve connectivity in at-risk areas, e.g. through:
 - Upgrading road transportation and infrastructure with the objectives to improve access to public services and markets of communities (particularly those isolated during annual floods or disasters).
 - Conducting risk assessments for high risk regions (e.g. sea level rise or landslide risk assessments).
 - Improving river transportation conditions, e.g. safer vehicles and river routes, good river management (e.g. clearing riverbeds and planting trees against river floods).
- Improve irrigation-drainage systems for enhancing climate resilience of agricultural and livestock production. For instance:
 - Introduce sprinkler and drip irrigation and supporting farmers to establish low cost and low maintenance small-scale community-managed irrigation schemes.
 - Improve irrigation canal and drainage systems. For example, rehabilitation/modernization of existing irrigation canal and drainage systems could increase water-use efficiency.
 - It must be highlighted that infrastructure measures alone cannot bring benefits, unless townships improve their overall water management (including the water supply and demand side). For instance, the water-use management at a farm level could be improved through establishing water user groups/committees and provision of trainings on water management and maintenance of water infrastructure.

Group work on climate change impacts and adaptation at a local level: infrastructure

Time needed : 45 minutes

Objective of this group activity: to identify climate change impacts on **infrastructure and human settlements** in a selected township, and propose options for adaptation.

Instructions: continuation of the previous session group activity.

Session 2.5 : Cross cutting issues: gender and DRR

Introduction to the session

Duration	: 135 minutes /two blocks of 45 minutes lecture and one block of 45 minutes group activity/
Training methods	: Lecture, open discussions, group activity
Materials required	: Projector, screen, PowerPoint slides and notes; printed materials for group activity, flip chart and markers, colorful sticky notes/cards (three different colors, e.g. green, orange, blue)

At the end of this session, participants should be able to:

- Explain what is gender and why it matters in CCA and DRR;
- Describe what makes women vulnerable to climate change and explain what is gender-responsive resilience to climate change and hazards;
- List activities for mainstreaming gender into CCA;
- List activities for integrating CCA and DRR at a local level.

Key points covered: gender, vulnerability to climate change of women, gender-responsive resilience, mainstreaming gender into CCA, integrating CCA and DRR

Training content

Cross-cutting issues: Gender and climate change

Climate change affects women and men differently

Women play an important role in achieving community resilience to climate change in Myanmar. Yet, they are more vulnerable to the effects of climate change than men especially in the case of female-headed households. For example, women tend to be poorer than men because of lower salaries and less income-generating opportunities. Furthermore, in many cases their contribution to the fisheries and agriculture sectors is informal (e.g. conditioned by traditional roles in community) and their labour not/less paid. Women also have lower access to information related to climate change and disasters than men. Unfavourable property/land tenure rights, and limited access to financing and information on adaptation, all these factors limit their adaptive capacity.



(Photo: UN-Habitat Myanmar website)

Climate Change Adaptation in Myanmar

How is climate change affecting women?

- Climate change could exacerbate existing inequalities such as inequality in access to land and other natural resources (threatened by climate change), or income inequality (access to jobs and payment rates).
- Climate change aggravates the burdens of unpaid care work, such as fetching water or wood, or taking care for the sick. For example, climate change increases health risks, which would affect family and community well-being, and hence burden women with additional unpaid care work.
- Pregnant women are facing health risks associated with the impact of various disasters and reduced access to clean drinking water.
- For many women, loss of safe housing and living environment caused by disaster or sea level rise could bring serious insecurity issues such as violence, sickness, or malnutrition.
- Women often rely on ecosystems to generate additional income and secure food for family. However, climate change will likely reduce agrobiodiversity including traditional medicine plants, and hence will affect women's livelihood.
- Secondary impacts of climate change on women and girls include reduced number of girls enrolled in schools and less opportunity for women to engage in income-generating activities.

How is climate change affecting men?

Men can also be severely affected by the impacts of climate change. For instance, climate change will likely lead to a loss of income in fishing and agriculture sectors, and men, being the prime breadwinners, could face challenges to adapt to new income-generating activities. Many of them will continue to migrate to urban areas (or abroad), where they could be exposed to other risks such as living in disaster-prone informal settlements.

What is gender?

“Women are not just victims of adverse climate effects due to their vulnerability; they are also key active agents of adaptation. This is due to their often deep understanding of their immediate environment, their experience in managing natural resources (water, forests, biodiversity and soil), and their involvement in climate-sensitive work such as farming, forestry and fisheries.”

(UNDP, 2010)

Gender: socially ascribed roles, responsibilities, rights and opportunities associated with being a man or a woman, and the social relations between women and men. These are dynamic, change over time and are context-specific (UN Women, 2014).

Gender equality: the equal rights, responsibilities and opportunities of women and men, and girls and boys, in society, at work and in the home (UN Women, 2014).

Gender roles and division of labour: gender role refers to what is expected, permitted and valued in a woman or a man in a certain place or culture. Gender division of labour is the allocation of the tasks and responsibilities of women and men at home, at work and in society. For example, often a division is made between: (a) productive tasks (e.g. agriculture, fisheries/aquaculture, self-employment, workers in enterprises); (b) reproductive tasks such as child care and household tasks; and (c) community tasks (UN Women, 2014).

Why gender matters in CCA?

- Considering both men's and women's needs, experiences and capacities throughout climate change related actions is critical for achieving long-term sustainability of CCA actions. Moreover, measures taken to address gender-based vulnerability can strengthen adaptive capacity of the society at large and impact communities' resilience.
- Women can often lead the way in adapting to climate change, for example through small-scale entrepreneurship and business, as well as through their experience in responding to environmental change at the household and community levels, including through traditional knowledge and practices.

How to identify gender-responsive adaptation measures?

Gender-responsive CCA means that the different socially determined roles and responsibilities, as well as specific needs, capacities and priorities of men and women are recognized and adequately addressed in the identification and implementation of adaptation measures so that both men and women can equally benefit.

To achieve this:

- Set targets for female participation in activities (e.g. that women are represented in all decision-making activities during adaptation planning and implementation processes)
- Apply a gender-sensitive approach to vulnerability assessment (Note: Vulnerability assessment tools and methods are discussed in Module 3, including gender-sensitive approaches)
- Identify policies that promote women's equality in terms of access to resources (land and financial), income generation opportunities, information, training and education. Those will strengthen women's coping and adaptive capacities.
- Identify, invite and engage women's groups, ministries and unions in CCA planning and implementation processes.
- Ensure monitoring and reporting on the integration of gender considerations into local climate resilience action plans.

Below are provided some options on how gender could be mainstreamed in sectoral CCA policies and measures:

- Economic empowerment of women:
 - Provide support and training for women's livelihoods, job skills and business development.

"Integrating a gender perspective into the National Adaptation Plan process can help to ensure that there is equal participation of men and women in the decision-making processes, as well as in the implementation of adaptation activities. Furthermore, it can help to ensure that the National Adaptation Plan process and the activities it entails will not exacerbate gender inequalities. It can lead to better adaptation, and more resilient communities."

(UNFCCC, 2012)

Climate Change Adaptation in Myanmar

- Develop policies that support decent work and entrepreneurship for women.
- Promote women's participation and leadership:
 - Promote women's participation and leadership in CCA in mixed groups. Raise awareness of communities on the importance of engaging women in CCA as they play a major role in the use of natural resources, securing food and income for family and contributing to community's development.
 - Develop and distribute to vulnerable communities awareness-raising brochures, which explain the relationship between gender roles and CCA planning and implementation.
- Reduce women's unpaid workload through improved access to basic services (water, energy, sanitation)
- Introduce policies/measures that enable women to have improved access/control over productive resources such as land, seeds, irrigation, credits.
- Strengthen the capacities of women through knowledge building:
 - Strengthen disaster preparedness and response capacity of women, and improve their access to disaster prevention, preparedness and early warning information at the local level, targeting the most vulnerable women through trainings and awareness-raising activities.
 - Develop and distribute gender-focused information materials and infographics, by engaging women in this process, capturing CCA and DRR activities.

Cross-cutting issues: integrating CCA and DRR

Many of the suggested actions for local response to climate change in this Module has the potential to reduce disaster risk. Some of them are summarized below.

- Introducing new crop varieties resistant to environmental stress
- Improved irrigation canal and drainage systems
- Diversifying farming systems
- Increased access of farmers to climate risk information
- Improved water resources management
- Forests conservation and rehabilitation
- Protect dry areas from hazards (droughts, wildfires)
- Upgrade transport infrastructure and services
- Improving river transportation conditions
- Improve housing, basic infrastructure and services
- Resilient urban transportation
- Improve access to health services, sanitation and hygiene
- Train local people on building-back better
- Social protection: Introduce job guarantee schemes and provide vocational/skill trainings
- Social inclusion: engage youth in CCA and DRR
- Awareness-raising and trainings on CCA and DRR
- Promoting women's participation and leadership in natural resources management, CCA and DRR

In addition, townships can integrate specific DRR measures into local climate resilience plans. For example, local governments can:

- Prepare for slow and rapid-onset disasters through climate-informed planning. For instance, local administrators can: (i) develop local disaster management plans and organize trainings for government staff; (ii) integrate changing disaster risk and uncertainties into local DRR and disaster risk management (DRM) planning by promoting the use of climate change data in disaster risk assessments, and strengthening the collaboration between DRR and CCA authorities (including hydro-meteorological institutions) for knowledge and information sharing; (iii) prepare local risk maps for agriculture and other key sectors to support adaptation planning.
- Enhance disaster preparedness and early warning, and promote the principle of ‘Build Back Better’. Examples of specific responses:
 - Raise disaster risk awareness among communities;
 - Build cyclone shelters than can also be used as schools/community centres.
 - Improve community’ capacities for storage and stockpiling of food/seeds to prevent loses due to floods, storms and heavy rainfall.
 - Adopt ecosystem-based measures together with communities. For example, building bamboo river embankments and other natural infrastructure can protect communities, fields and other assets from excess water, including salt water, as well as from flooding and erosion.
 - Mobilize local volunteer groups to support disaster preparedness, early warning and early response activities, and provide necessary trainings.
 - Promote establishment of community-run early warning systems.
 - Adopt community-based projects for post-disaster reconstruction and rehabilitation of homes and community infrastructure, applying “Build Back Better” principles. For example, provide trainings to affected communities on how to build safe houses after disaster using local materials.
- Improve the access to education, and promote climate resilient and safe schools. Examples of proper actions:
 - Plan for future climate risks when selecting sites for new school buildings (e.g. sea level rise projections; flood/landslide risk; connectivity under future climate).
 - Conduct risk assessments of local schools and undertake actions to make school buildings safe.
 - Build schools that have a double-use, e.g. as cyclone/heat-wave shelters or community centres, employing disaster-resilient design.
 - Build water storage facilities for schools in drought-prone regions.
 - Train teachers and school children on safety measures during disasters and climate extremes.

Group work on climate change impacts and adaptation at a local level: linking ecosystems, socio-economic systems and infrastructure, and integrating gender and DRR

Time needed: 45 minutes

Objective of this group activity: (i) to identify gender-differentiated impacts of climate change in a selected township, and propose options for gender-responsive adaptation; (ii) to develop comprehensive vulnerability profile and adaptation response by linking ecosystems, socio-economic systems and infrastructure, and integrating gender and DRR into CCA.

Instructions: continuation of the previous session group activity.

Additional readings

MNREC (2012). Myanmar Initial National Communication under UNFCCC. Ministry of Natural Resources and Environmental Conservation.

Horton, R., De Mel, M., Peters, D., Lesk, C., Bartlett, R., Helsingin, H., Bader, D., Capizzi, P., Martin, S. and Rosenzweig, C. (2016). Assessing Climate Risk in Myanmar. New York, NY, USA: Center for Climate Systems Research at Columbia University, WWF-US and WWF-Myanmar.

MODULE 3

ASSESSING VULNERABILITY TO CLIMATE CHANGE AND HAZARDS AT A LOCAL LEVEL

Session 3.1 : Vulnerability assessment: purpose and methodology

Introduction to the session

Duration : 135 minutes /three blocks of 45 minutes/

Training methods : Lecture and case studies presentation

Materials required : Projector, screen, PowerPoint slides and notes

This session introduces the process, methodology and tools for conducting vulnerability assessment at a local/township level. At the end of the session participants will know the principles and methods for assessing vulnerability, and be theoretically prepared for a practical exercise (covered in the next session).

Key points covered: climate change vulnerability assessment, developing township profile, computing hazard risk index, participatory approaches to vulnerability analysis, scenario development

Training content

Purpose of climate change vulnerability assessment

Before identifying appropriate CCA actions, township/local administrators should understand the local vulnerabilities including the most vulnerable economic sectors, social groups and communities (Figure 22). This can be achieved through a vulnerability assessment, which is a process of identifying, measuring (quantifying) and analysing vulnerability to climate change and hazards.



Figure 22 : Phases of adaptation assessment and planning

In the context of township vulnerability assessment, the process consists of identification and analysis of socio-economic, physical and environmental factors, which determine the sensitivity/susceptibility of the township to the impact of climate change (e.g. increasing temperatures, change in seasonal patterns) and/or hazard (e.g. flood, drought), using qualitative and quantitative methods.

The purpose of local vulnerability assessments is to inform township, regional and national authorities (and international development organizations/donors) on:

- potential consequences of climate change in a short-, medium-, and long-term;
- underlying causes/factors of vulnerability including ecological, socio-economic and infrastructure;
- the most vulnerable locations, sectors and social groups.

Planning a vulnerability assessment

- Set clear objectives, aim, time-horizon (e.g. short-term year 2025, or long-term year 2050) and expected outcome of the vulnerability assessment.
- Define the available financial and human resources, and desired time-frame to conduct the vulnerability assessment. When resources and time are limited, township officials can choose rapid vulnerability assessment (taught in this course). Advanced assessment including spatial analysis (not covered in this course), would require personnel with relevant technical skills (such as GIS, statistics, and climate risk modelling).
- Select a multi-disciplinary team of 3-5 members, and choose a Team Leader. It is essential to have at least one environmental specialist, one socio-economic development specialist and one urban/regional planner, architect or engineer. For advanced (spatial) vulnerability assessment, GIS specialist should also be included in the team. Supportive role could have representatives from other sectors. Specialists from the following departments could be considered for the assessment team:
 - Agriculture, fisheries and livestock departments
 - Forestry, environment and tourism departments
 - Water, energy and industry departments
 - Infrastructure and transport departments
 - Township development planning department
 - Disaster risk management department
 - Education and health departments
- Assessment teams should decide on the specific methods and tools that will be used (depending on the available resources and time).
- Check data availability and request secondary data well in advance (e.g. Census 2014 data, or local level climate/weather data).
- Develop a plan for the vulnerability assessment and assign specific tasks to each group member. These should account for: a desk review of relevant documents/literature; collecting secondary and primary data (e.g. Census 2014 data; survey with village administrators); township and community level participatory

workshops (see participatory tools and methods in Section 3); data processing and analysis; and developing a final report.

Vulnerability assessment: process, methods and tools

STEP 1 Developing a township profile

At the first step, township officials should develop a township profile, i.e. a basic description of physical and environmental characteristics, demographic trends, and governance structure. The following list provides guidance and recommendations on formulating a township profile.

Physical and environmental characteristics

- Basic geography: location and physical characteristics (e.g. topography); major cities, towns and human settlements (administrative divisions)
- Local climate such as average annual/seasonal temperatures and rainfall, wind patterns
- Natural resources including their spatial distribution (location) and state (e.g. level of environmental degradation and resource depletion):
 - marine and coastal ecosystems; coastal erosion and inundation
 - water resources and hydrology; seasonal variation in water availability (e.g. rivers, groundwater); water quality
 - forests and vegetation cover, and observed changes
 - soils and soil nutrient status
 - land use and drivers of change
 - biodiversity

Demographic overview

- Basic demographics: number and density of the population, age structure, rural/urban ratio, male/female ratio
- Socio-economic demographics: household type and size, per cent of female headed households, poverty levels, migration trends, child mortality, literacy rate/level of education, economically active/inactive population (out of which women), labour-force participation. If available, use sex and age disaggregated data. Pay attention that statistical data can be biased because women's work such as post-harvest processing, net and basket making, and marketing of crops and fish, might not be considered as an 'economically active participation' in the existing statistical databases.

Administration and governance

- Key development/sectoral plans and priorities at the township level and status of integration of climate-related issues
- Description of governance structure and capacities of townships. For instance, township officials might consider including a list of state institutions, which play a role in CCA, and briefly describe their capacities (technical, financial, human). Information can be obtained through consultations with representatives from various departments.
- Village/community level informal governance structures (e.g. village leaders)

Climate Change Adaptation in Myanmar

Suggested tools and methods

- Graphic presentation of statistical data in Microsoft Excel. For example, a demographic chart, pie chart or column chart can be generated using the 2014 Census tables (Figure 23).

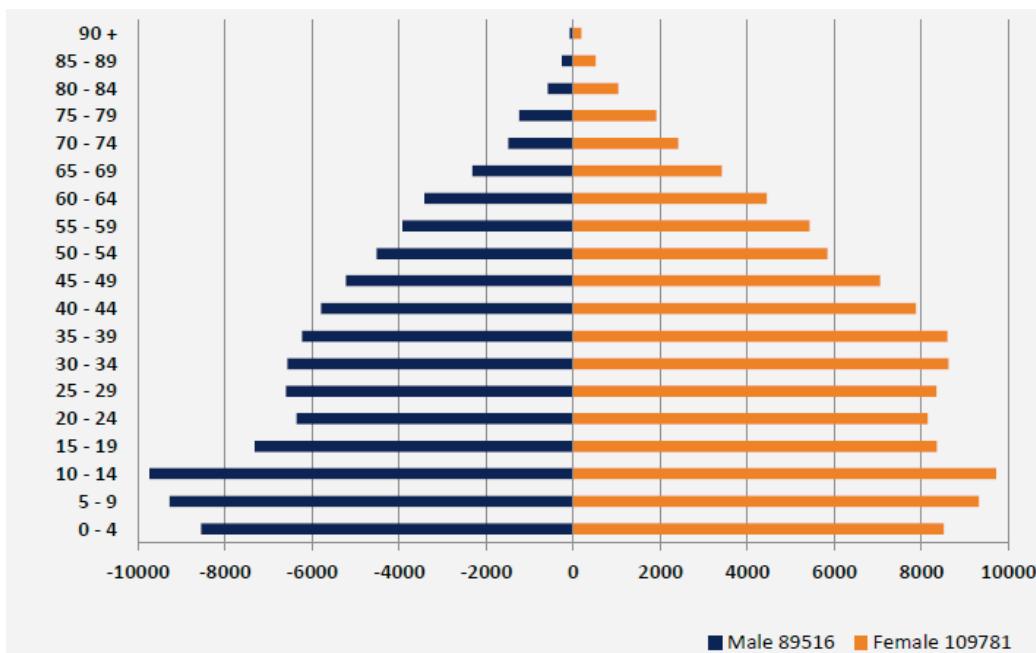


Figure 23 : Example of a demographic chart: Rural population pyramid for Pakokku Township
(Source: Fee, L. et al., 2017 (b))

- Township mapping: involves a spatial presentation of township's key features. This can be done by printing a large physical map of the township of interest. Township officials can add to the map other important information (ecosystem, infrastructure, and socio-economic features) either by drawing directly on the map or by using sticky notes.

Data sources

- Township maps: Myanmar Information Management Unit (MIMU) (<http://www.themimu.info/gis-resources>) or Google Maps.
- Information on climate and environmental features (e.g. soil type, hydrology, crops and land use): information can be requested from respective township departments.
- Census data: most of the necessary information for the development of township profile can be obtained from the 2014 Myanmar Population and Housing Census (<http://www.themimu.info/census-data>). Double-check if there have been any changes in the administrative boundaries of the township of interest since 2014.

STEP 2 : Assessing current vulnerability to climate change and hazards

2.1. : Identifying and analysing observed climate changes:

Assessment teams should obtain information on observed changes in local climate and its variability, as well as trends in frequency and magnitude of climate extremes (if possible for the last 30 years).

Key climate change indicators and observed trends across the country are:

- Increase in mean seasonal and annual temperatures
- Increase in daily maximum temperatures and number of hot days, more frequent heat waves
- Shorter monsoons
- Erratic rainfall patterns - increasing rainfall intensity (especially during the wet season) and decreasing number of rainy days
- Sea level rise
- Increase in frequency and magnitude of climate hazards:
 - increasing risk of coastal hazards (flooding, storm surges, strong winds)
 - increasing risk of forest fires
 - increasing risk of erosion and landslides
 - more frequent occurrence of drought and flood events
 - increasing intensity and frequency of cyclones

Suggested tools and methods

- Time-series hydro-meteorological data analysis (for observed trends at the national and sub-national levels see Annex I). For instance, the following variables could be analysed:
 - trends in average, minimum and maximum monthly and seasonal temperatures and precipitation
 - change in the length of monsoon period
 - change in frequency and severity of extreme events.

Obtaining time-series data at the township level could be challenging. In such case, a mix of regional level data analysis, and bottom-up approaches such as interview or survey could be applied.

- **Group or individual interviews with community members:** this method involves facilitating a discussion on community perceptions and direct observations of changes in local climate. Older people often could provide valuable historical information. It is recommended that facilitators of this process guide the discussion through specific questions such as:
 - Do you think that temperatures are changing? Is it now cooler or warmer than before?
 - How are seasons changing?
 - Is the rainy season getting shorter or longer compared to 20-30 years ago?
 - Is it raining when it is not supposed to rain nowadays?
 - Do you think that sea level is rising? Can you recall if the coastline was wider before?
 - Can you recall some major hazards experienced in your area (e.g. floods, droughts, cyclones, heat waves)?

2.2. Analysing factors of vulnerability to identify vulnerable sectors and groups

This part of the vulnerability analysis aims to explore experienced climate change impacts and identify causes of vulnerability. The analysis should be built upon in-depth understanding on those key characteristics of the selected township, which condition its vulnerability or resilience to climate change and hazards, as described below.

Ecosystem conditions: what should be described?

- Key ecosystem services:
 - Access to ecosystem services such as access to water for drinking and irrigation, productive land, or marine resources
 - Livelihood dependency on ecosystem services (forests, agriculture and fishing, marine ecosystems)
 - Environmental issues such as erosion, deforestation, pollution of water resources (e.g. from agriculture), overfishing, unsustainable land use and agricultural practices.

Socio-economic conditions: what should be described?

- Economic profile:
 - Annual output per capita and key productive sectors (e.g. agriculture, fisheries, textile industry, food processing industries, etc.) as well as their contribution to the local economy (sectoral output and employment opportunities)
 - Main agricultural output and level of economic dependency on a specific production (e.g. rice or certain type of fish); level of agricultural production diversification
 - Dominant form of farming and entrepreneurship (small, medium or large farms/businesses)
 - Access to resources such as land and financing
- Livelihood profile: main sources of livelihood and level of household income diversification; household food security; rural-urban differences
- Social issues:
 - Gender roles in community:
 - identification of the roles of men and women in family and community
 - analysis of gender equality: income generating opportunities for women/men, unpaid work women/men, daily wage women/men
 - access of women to resources (especially of women heads of households) such as land, assets (house), financing
 - Identification of socially and economically vulnerable groups such as minority groups and people with disabilities
- Health issues: overall health status and key health risks in the township related to climatic conditions and hazards

Infrastructure and connectivity conditions: what should be described?

- Description of hard infrastructure such as road network, bridges, drainage system, energy and water infrastructure and facilities, water infrastructure for irrigation and livestock use
- Description of housing conditions (construction materials and techniques used) and access to basic services including:

- Water and sanitation – main sources of and access to drinking water, household water storage and sanitation facilities
- Energy – access to electricity and main sources of energy (e.g. hydropower energy, wood harvesting)
- Telecommunications – access to radio, television and the Internet
- Transportation system: land and water transport systems
- Description of location, accessibility and safety of markets and public facilities:
 - Basic health and education coverage; areas/communities with low access to markets and public facilities (hospitals, schools).
 - Cyclones/emergency centres coverage
 - Disaster resilience of public buildings
 - Connectivity challenges during seasonal floods and most affected areas in the township
 - Access to early-warning systems.

What should be analysed in this section?

For each of the three components described above (ecosystems, socio-economic and infrastructure), the following main questions should be addressed:

- How do observed changes in climate (including climate variability and hazards) affect the selected township (considering environmental, socio-economic and infrastructure aspects)? To the extent possible, include a broad spectrum of issues such as observed impacts on:
 - crops production, fisheries and livestock
 - land productivity and water availability
 - forests and biodiversity
 - marine and coastal ecosystems
 - local economic growth, and sectoral growth rates
 - poverty levels and migration
 - access to water and energy
 - transport infrastructure and services
 - health of the population
 - access to schools, hospital and other public facilities.
- Which sectors, social groups and locations have been most impacted from recent climatic stress? Why, what makes these sectors, groups and communities vulnerable?
- What non-climatic factors have exacerbated the severity of climate change impacts? (e.g. deforestation, expansion of agricultural land)
- What coping or adapting practices/measures exist at community and township levels?

To identify gender-responsive CCA actions and tailor local climate resilience action plans that addresses the needs of both men and women, the vulnerability analysis should be gender-sensitive.

Gender-sensitive approach to vulnerability assessment means to understand and give consideration of the different rights, roles and responsibilities of women and men in the community and the relationships between them in the context of vulnerability to climate change and hazards.

What makes women vulnerable to the impacts of climate change?

- Limited access to resources: in some cases, women have limited access to crucial resources such as land, livestock, tools, and credit. Even in cases where women may have access to land, they have limited control over it, as they do not own it and therefore cannot make decisions regarding its use.
- Dependence on natural resources most at risk from climate change such as water and trees.
- Higher level of poverty, especially of women heads of households, because of informal employment, lower salaries and less income-generating opportunities.
- Limited access to education, skills development and information. For example, girls often receive fewer years of education than boys. Climate change would affect the income of low-income families and this could further affect the access to education. In turn, lower education level can affect girls' ability to: (i) understand and act on information concerning climate risks and adaptation measures; (ii) generate income.
- Limited participation in decision-making conditioned by traditional gender roles. As a result, women's needs and capacities are often neglected.
- Traditional women's occupations in community and family life, and responsibilities of caring for others increase the risks posed by climate change. For example, in case of a disaster women try to protect and save their relatives, which often hinder their timely escape, and access to shelter and health care. In addition, women are often socially restricted from leaving their communities (migrating) as a coping mechanism (used by men).

(UNDP, 2016; UNEP, 2016)

Gender-sensitive vulnerability analysis implies that:

- Both qualitative and quantitative data used in vulnerability assessment has been gathered and analysed disaggregated by sex (and age).
- Both men and women have been consulted separately, for example in focus group discussions, about their perception of climate change, hazards and livelihoods.
- Vulnerability assessment report clearly describes how observed/projected climate change affects/could potentially affect women and men differently.

Example: findings from Labutta Township

In Myanmar, the roles women in small-scale fisheries include post-harvest processing, net-building, and selling of fish. In the case study of Labutta, research findings showed that women have primary responsibilities for cleaning, smoking, salting, drying, and selling fish and seafood products at local markets. Women also pick shrimps and crabs, and dry and sell these products for extra income or to secure food for their families. However, such fishing work is often conceptualized as "not fishing", but an extension of women's traditional role of unpaid household labour. Furthermore, in the seafood industry in Labutta, men earn 5000 Kyat per day, while women only 3000 Kyat.

Guiding questions for exploring gender-differentiated vulnerability to climate variability and change in townships of Myanmar are outlined in Annex IV.

Data sources

- Township maps: Myanmar Information Management Unit (MIMU) (<http://www.themimu.info/gis-resources>) or Google Maps.
- Information on climate and environmental features (e.g. soil type, hydrology, crops and land use): information can be requested from respective township departments.
- Ecosystems and services: MIMU map, community consultations and participatory mapping.
- Census data: most of the necessary information for the development of township profile can be obtained from the 2014 Myanmar Population and Housing Census (<http://www.themimu.info/census-data>). Double-check if there have been any changes in the administrative boundaries of the township of interest since 2014.
- Census data at the village tract/urban ward level can also be requested from the Department of Population of the Ministry of Labour, Immigration and Population.
- Data on hard infrastructure, and productive and livelihood sectors: Township General Administration Department (GAD).

Suggested tools and methods

- **Descriptive** analysis of impacts based upon national and regional level observations, and township level statistical data (if available). For instance, an analysis of historical climate data and agricultural output data can reveal the impact of climate variability and hazards on crops and livestock. Further, an analysis of climate data and output per capita can show if significant climate-related events have affected economic growth and poverty levels, and inform on the most vulnerable locations (e.g. regions of Myanmar).
- Participatory approaches such as **consultation with communities** can complement the analysis. Discussions should be tailored to capture:
 - Climate change impacts on multiple sectors (e.g. ecosystems and agriculture; water and energy; transportation and industries).
 - Social aspects of vulnerability (e.g. ask community members which social groups have been most affected from experienced hazards).
 - Gender vulnerabilities (e.g. a female facilitator could conduct a separate consultation with women and girls because some women may find it easier to express their problems, needs and views in a women-only group). Sample questions for exploring gender-differentiated vulnerability to climate variability and change are provided in Annex IV.
- Detailed village level data (not covered in available statistical sources) could be obtained through **semi-structured interviews**.

What is a semi-structured interview?

Semi-structured interview is a discussion in an informal way using open questions. Group interviews and focus group discussions are types of semi-structured interviews.

- *Group interview* is a type of semi-structured interview, which aims at obtaining community level information.
- *Focus group discussion* is a type of semi-structured interview, which aims at discussing a specific topic in detail with a small group of persons who are well familiar with the topic of interest.

How to facilitate a group interview and focus group discussion?

- Prepare a list of key issues in advance and select one person from your group to lead the interview (nevertheless, the other group members can also ask questions)
- Use open-ended questions such as 'what', 'why', 'who', 'when' and ask for concrete examples; if you have questions arising from the given answers, ask new questions
- Try to involve everyone from the focus group to express opinion and share information.

(MNRE Lao PDR, 2016)

- **Local surveys.** For instance, in the case studies of Pakokku and Labutta, a questionnaire was distributed to village representatives to obtain information on functions available in each village tract such as public utilities, health facilities and markets, among others. In addition, focus group discussion was used as a tool for conducting gender analysis in Labutta.
- Township maps with detailed community level information could be developed through **participatory mapping**. For example, together with a facilitator, community members can be asked to sketch village/ward boundaries, connectivity (roads, waterways), as well as location of markets, drinking and irrigation water sources, and main ecosystem services. Information obtained from each town/village/ward can then be summarized in a Microsoft Excel table and key area features highlighted on the township map.

What is participatory mapping?

Participatory mapping is a process of drawing a village/community map based upon information and knowledge shared by local people. It is recommended that women, men, and children from different social groups participate in this process.

Participatory mapping could be used to develop community and hazard/risk maps:

- Community mapping is used to indicate the spatial location of natural resources (main ecosystem services), land-use types (e.g. forest area, agricultural fields and residential areas), important community assets and infrastructure (e.g. roads, bridges, energy grid, water infrastructure and utilities), and other features.
- Hazard/risk mapping could be viewed as an extension of community mapping. It illustrates the hazard-prone locations, as well as people, ecosystems and assets most at risk of hazards such as floods. Other information that could be mapped include: safe areas/route to safe areas, and local capacities such as rescue posts.

Steps in participatory mapping:

- Decide what kind of information is needed and prepare a list of questions. Bring necessary materials for the mapping (e.g. printed map of the area, flip chart, markers and pencils, paper/transparent paper, colour paper/sticky notes, etc.).
- Find and gather community members who know the area and are willing to share their knowledge.
- Ask people to draw the map by guiding them with your questions. Encourage women and children to express their opinion.
- Write down key points, and at the end, present summary of findings for final feedback from the community.

- **Participatory risk mapping** through consultation with communities: involves mapping of the most exposed locations (of people, infrastructure and assets, crops and livestock) affected by hazards.
- Developing a **seasonal change calendar** together with communities is a useful tool to identify how recent climate changes affect community livelihood. The calendar could be developed by drawing a simple table on a flip chart as shown below. Key events relate to any significant for the life of a community event during a year such as planting and harvesting, start of school year or seasonal income generating opportunities. Climate indicators (columns three and four) could be temperatures, timing and intensity of rainfall, wind patterns, and types and occurrence of hazards. Observed impacts relate to any hardship or loss experienced by community due to observed changes such as disruption of annual events cycle. For example, a shift/change in seasonal patterns could affect the growing period, while annual floods may disrupt access to school and affect small-scale producers. It is recommended that facilitators of this exercise ask guiding questions but leave community members to fill the table on their own.

Example: Seasonal changes calendar

Season (length)	Key events (annual cycle)	Typical climate	Observed changes	Observed impacts
Hot season (March-May)				
Wet season (June-October)				
Cool season (November-February)				

2.3. Developing current disaster risk profile (risk index) to map most vulnerable and at-risk locations

Developing indicators and computing a **vulnerability and risk index** could support the analysis by providing an overview of the most vulnerable locations to current climate hazards.

Methodology for selecting indicators to measure vulnerability and calculating current vulnerability index:

- List measurable indicators that correspond to key factors of vulnerability (see *Table3*)

Climate Change Adaptation in Myanmar

Table 3 : Sample list of indicators for measuring vulnerability

Component	Sample list of indicators
Exposure to hazards	Exposure to floods Exposure to drought Exposure to strong winds Exposure to storm surge and salinization due to sea level rise Exposure to cyclone
Ecosystem	Access to drinking water Access to irrigation water Quality of forest Share of rain-fed agricultural production in the total agricultural output Crops production diversification Land productivity/soil quality
Socio-economic	Level of education completed Income per capita Labour-force participation rate Income dependency on agriculture or fisheries Population density
Infrastructure	Type of household units Access to basic services Access to transportation Access to cyclone shelters Access to protection shelters Water infrastructure and level of diversification of sources of drinking water Energy infrastructure and level of diversification of sources of energy

- Choose two to four variables to measure exposure to hazards and each component of vulnerability (ecosystem, socio-economic and infrastructure). Select the most relevant indicators and ensure that data is available and accessible.
- Collect data and develop spreadsheet table using available computer software (e.g. Microsoft Excel). The first column should contain list of towns/villages/human settlements in the selected township. The rows should contain data on the selected indicators.
- Group the data values of each variable into four categories: 1 to measure the lowest and 4 the highest level of vulnerability conditioned by the respective variable (see Table 4.).

Table 4 : Example: Categorizing variables¹⁸

	Exposure to floods (exposure)	Access to drinking water (ecosystem)	Level of education completed (socio-economic)	Type of housing units (infrastructure)
1	Location in a rain-fed area	50% households having access to surface water and 50% having access to groundwater	75-100% population 25 years and over with high school, diploma or vocational training completed	0-25% houses built with local materials
2	Location close to a seasonal stream	0-25% households having access to surface water	50-75% population 25 years and over with high school, diploma or vocational training completed	25-50% houses built with local materials
3	Location in a flood-prone area (river-bank area)	50-75% households having access to surface water	25-50% population 25 years and over with high school, diploma or vocational training completed	50-75% houses built with local materials
4	-	75-100% households having access to surface water	0-25% population 25 years and over with high school, diploma or vocational training completed	75-100% houses built with local materials

- The information can then be analysed using various software tools. In addition, current vulnerability index for each town/village could be generated using the following formula:

$$\text{Vulnerability Index} = \sum (\text{ecosystem, socio-economic, infrastructure values}) \times \sum (\text{exposure values})$$

Note: 'Value' refers to number of category (1,2,3 and 4).

Example:

Refer to Table 3. Assume that: (i) village A is located close to a seasonal stream (i.e. vulnerability category 2); (ii) 50-75% of the households have access to surface water (vulnerability category 3); (iii) only 0-25% of the population have completed education (vulnerability category 4); and (iv) 50-75% of the houses are built with local materials and hence are not climate resilient (vulnerability category 3).

$$\text{Vulnerability Index for village A} = (3+4+3) \times 2 = 20$$

- After calculating vulnerability index for each town/village, ranking of the most vulnerable locations could be easily performed (Figure 24).

18 Extracted from: Fee, L. et al., 2017(a) (forthcoming)

Climate Change Adaptation in Myanmar

SENSITIVITY INDEX													HAZARD INTENSITY (frequency/magnitude)													
ECO-SYSTEMS				SOCIO-ECONOMIC				INFRASTRUCTURE					SEA-LEVEL RISE		INTENSE RAINS		INCREASE IN MEAN TEMPERATURE		Total Sensitivity Index	Storm surge	Salinization	Flooding	Cyclone	Drought/Heat Waves	Total Exposure Index	Total Risk Index
11. Access to drinking water	12. Quality of the forest	13. Access to irrigation water	14. Level of education completed	15. Income per capita	16. Labour force participation rate	17. Type of housing units	18. Access to transport services	19. Access to cyclone shelters	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.		
Village Tract																										
Nyung Lai	2	4	2	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kyauk Tan Gyi	1	6	2	4	2	2	2	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Yar	2	4	2	4	2	2	2	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
The Li Kar Kong	2	3	2	4	2	2	2	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Pan Toon Kweiss	2	4	2	4	2	2	2	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Myint Hauk	2	3	2	4	2	2	2	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kyain Kone Gyi	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Lagutta Loop Myayal	3	3	3	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Ta Yet Kone Le Pyaw	2	3	1	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Ukha	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Muang Ngap	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kyauk Tan Ka Lay	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Tha Nup Phat	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Ludu	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Hisi Bon	4	3	3	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kyauk Mhaw	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Hsin Pon Kwei	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Toung	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Ka Ta Paund	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
A Mai	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Ba Thar Kone	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Nyaung Kyauk	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Bo Pyaw	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Ka Kone Kyaw	4	4	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kan Bell	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Nyaung Chaung	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Otn Ta Pha	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kye Chaung	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kye Kain	4	4	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Min Htun	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Shwe Chaung	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kyauk Chaung	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Fay Chaung	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Mang Tei	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Bay Paul	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Nyan Kweeen (Kan Yai)	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Laput Paye Le Pyaw	4	4	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kye Chaung	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kye Kain	4	4	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Min Htun	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Lagutta Loop Myayal	2	2	2	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Tai Daunt Chaung	3	3	1	4	4	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Sar Chock	2	3	2	4	4	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Da Nai	3	2	3	4	4	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Phone Gyi Kone	3	3	3	4	4	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Gant Eust	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kone Gyi	3	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Pu Pu	4	3	2	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Ser Kyai	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Miyt Paul	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Kok Koi	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Khi Nyi	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Urban Pansali	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Sa Lu Sein	4	2	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Tet Pin Kali	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Yeal	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Miao Zai	4	3	4	4	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Tha Pyu Kone	4	3	3	4	4	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Thin Gan Gyi	4	3	4	4	2	2	2	4	1	1	1	1</td														

- Potential impact pathways graph** (see Module 2) is a visual presentation of the complex relationship between projected climate changes, potential hazards and multiple primary and secondary impacts. The graph could be developed through a review of national and sub-national level studies on potential impacts (discussed in Module 2), analysis of secondary data at the township level, and consultation with communities. Summary table of potential impacts is attached as Annex II.

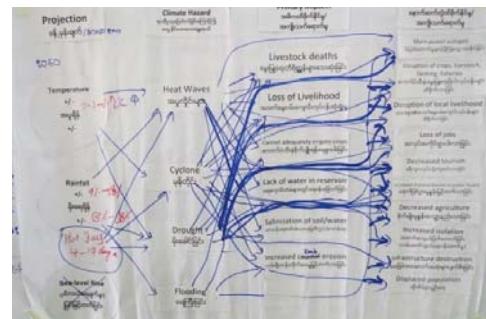


Photo: Potential Impact Pathway graph for Pakokku (Credit: MCCA/UN-Habitat)

3.3. Summary of findings and scenarios for the township

The vulnerability assessment findings could be summarized in a table and key messages highlighted. Emphasis should be placed on current vulnerabilities and potential future impacts on ecosystems, socio-economic systems and the built environment. Results should show the most vulnerable sectors, social groups and locations in the selected township to current and future climate pressures.

The next step is to identify scenarios and develop a vision of the future based upon the vulnerability assessment results. To achieve this, assessment teams should present their findings to a broad range of stakeholders. The best way is to organize a consultative meeting where policymakers can discuss future scenarios and agree on a long-term CCA pathway.

Difference between a scenario and forecast:

- A forecast suggests one pathway to the future (Figure 25 (a)). For example, using technology we can forecast when a storm or cyclone will reach Myanmar.
- Scenario is a possible future state of climate, environment and socio-economic characteristics of township. Therefore, scenario planning involves considering how multiple variables (e.g. climate, ecosystems, infrastructure, and socio-economic variables) could change and lead to multiple futures (e.g. high climate change impacts, or medium climate change impacts) (Figure 25 (b)). Scenario planning is considered a more effective way for governments to plan so-called 'no-regret' actions.

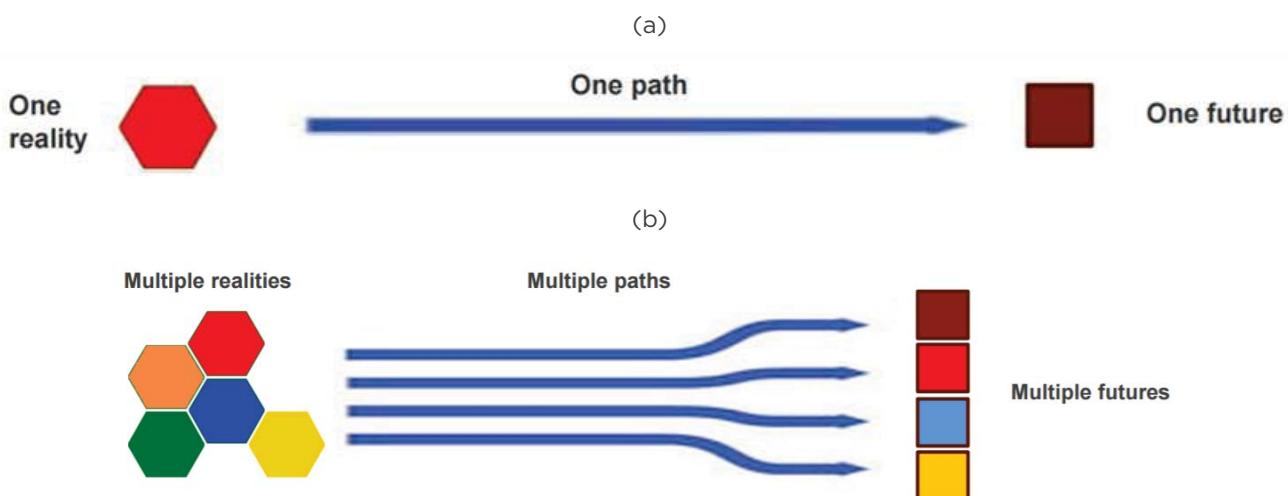


Figure 25 : Graphic representation of forecast (a) and scenario (b)²⁰

20 Graphics taken from Economist Intelligence Unit (2016) – New Directions: Myanmar to 2030, PowerPoint presentation.

Climate Change Adaptation in Myanmar

The objective of using scenarios to develop policies is to ensure that a broader range of possible options is considered. Three broad scenarios of the future, which can help local and national governments to plan for local CCA actions are proposed below (Table 5).

Table 5 Suggested scenarios for 2050²¹

Scenario	Required response and impact
A: Business as Usual	<p>Response: authorities and communities do not recognize the urgent need to address current and future climate change impacts and vulnerabilities, and no action is taken.</p> <p>Impact: climate change will increasingly affect people's life, livelihoods, health and safety until 2050 and beyond; current socio-economic and environmental vulnerabilities will aggravate; development will be impeded.</p>
B: Resilience is built to maintain current living standards by 2050	<p>Response: authorities and communities recognize the urgent need to address current and future climate change impacts and vulnerabilities. However, there are limited capacities for large-scale investments and CCA responses (financial, technical and human constraints).</p> <p>Under this scenario, local adaptation plans can focus on:</p> <ul style="list-style-type: none"> • Improved environmental management, sustainable natural resources utilization and land-use planning, ecosystems restoration and conservation, introduction of climate-smart agricultural practices • Limited investment in infrastructure but sufficient to ensure that functionality is maintained to present levels, e.g. improving transport infrastructure and networks, and access to public services; and diversification of water and energy sources at a community or household level. • Small-scale socio-economic measures such as agricultural production diversification, and improved access to microfinance/loans. <p>Impact: while climate change will affect people's life, livelihoods, health and safety until 2050, townships can maintain current living standards; however, social development and economic growth would be challenged by climate change.</p>
C: Resilience is built that enables economic and social development, despite changes in climate by 2050	<p>Response: authorities and communities recognize the urgent need to address current and future climate change impacts and vulnerabilities, and are committed to implement a wide range of low- and high-cost CCA measures. Townships have the support of national authorities and international partners to achieve environmental, infrastructural and socio-economic objectives. These could be:</p> <ol style="list-style-type: none"> 1) Healthy ecosystem that sustains life; 2) Resilient infrastructure that protects people and promotes development; 3) Diversified economy that supports sustainable and resilient economic and social development. <p>Impact: climate change will affect people's life, livelihoods, health and safety until 2050, and beyond; however, townships will be able to maintain current living standards and to achieve development goals.</p>

²¹ This table is developed based upon vulnerability assessment studies conducted in Labutta and Pakokku (Fee, L. et al., 2017(a) and (b)).

STEP 4 Scoping adaptation responses: developing a long list of options

At this step, township officials should develop a long list of options through consultations with communities and relevant stakeholders. Summary of potential adaptation options is provided in Annex III. (Note: these options will be further assessed and prioritized in Module 4).

STEP 5 Developing Vulnerability Assessment Report

At the end of the vulnerability assessment process, assessment teams should document the results in the form of a report. The structure of the report could follow the steps of vulnerability analysis as outlined in the table below.

Table 6 : Proposed table of contents

Scenario	Required response and impact
Executive summary	Brief overview of purpose, objectives and methods of the assessment, and summary of main findings.
1. Introduction	The introductory chapter could set the background and clarify the objectives of the assessment. Brief description of the methodology and limitations of the analysis could also be highlighted.
2. Township profile	Overview of physical and environmental characteristics, socio-economic characteristics, infrastructure and connectivity profile, administration and governance
3. Current vulnerability to climate change and hazards	Overview of observed climate changes and analysis of factors of vulnerability Current vulnerability index Summary of current vulnerabilities: vulnerable sectors, social groups and locations
4. Future climate change risk	Overview of future climate change projections and potential impact pathways
5. Overall findings and outlook	Summary of findings and scenarios for 2050 Summary of potential adaptation options as identified through consultations (long list of adaptation options)
Annexes	Any relevant information such as list of communities included in consultations, survey questionnaires used to collect data, summary of statistical data used, etc.

Session 3.2 : Practical exercise: rapid vulnerability assessment

Introduction to the session

- Duration :** more than two days /two blocks of 45 minutes introduction to the field exercise; one day field work and one day analysis of results in class/
- Training methods :** On-the-job exercise including use of participatory tools (field visit), group discussions, data synthesis and analysis, presentations
- Materials required :** Projector, screen, PowerPoint slides and notes, computers and printer (if available), flip chart and paper, markers, pens, printed maps and transparent paper, sticky notes, note cards, tape, hand-outs (Annex V.3 and V.4)

Note: Annex II and Annex III could be distributed to participants as a guide on identifying potential climate change impacts and response actions.

The activities in this session will give participants an opportunity to apply the knowledge they have gained from Session 3.1 and the previous modules. More specifically, participants will conduct real case study vulnerability assessment. The practical exercise is divided into two activities:

- **Activity 1:** Field exercise on vulnerability assessment and adaptation planning
- **Activity 2:** Vulnerability assessment: synthesis and analysis of field exercise and secondary data

Activities

Activity 1: Field exercise on vulnerability assessment and adaptation planning

Process and methods
<p>Activity 1.1. Introduction to the field exercise</p> <ul style="list-style-type: none">⌚ Two blocks of 45 minutes• Provide background information on the selected case study such as location, and socio-economic and climate risk background information (15-20 min).• Divide participants into three groups. Each group will use two of the participatory tools for data collection presented in Session 3.1. The groups must have balance of men and women, and people with various backgrounds as suggested below. More specifically, the following groups could be formed²²: <p>Group 1: Ecosystems and agriculture group</p> <p>Suggested team composition: representatives from environment, forestry, water and agriculture sectors</p> <p>Participatory tools to be used:</p> <p>Tool 1 - group interview with community members with focus on ecosystems profile, observed climate changes and impacts on ecosystems and agriculture</p> <p>Tool 5 - community seasonal calendar to identify observed climate changes and impacts on livelihood</p>

²² This is a suggested division. Facilitator should form groups depending on the background of course participants in each specific case.

Process and methods
Group 2: Socio-economic group
Suggested team composition: representatives from socio-economic sectors (education, health, employment, economic development, etc.)
Participatory tools to be used:
Tool 2 - group interview with community members with focus on socio-economic profile, observed climate changes and socio-economic impacts
Tool 6 – focus group discussion with community members (women and girls) to explore gender roles and vulnerabilities
Group 3: Infrastructure and participatory mapping group
Suggested team composition: representatives from relevant sectors, e.g. irrigation, water resources, rural development, DRR, other.
Participatory tools to be used:
Tool 3- group interview with community members with focus on infrastructure profile, observed climate changes and impacts on infrastructure
Tool 4 – participatory community and risk mapping
<ul style="list-style-type: none"> Brief participants on the types of tools they are going to use (depending on their group activity) and distribute hand-outs. Give 10-15 minutes to participants to read the provided materials and encourage questions related to the field work. Ask each group to prepare a list of specific questions based upon the background information for the case study, which will guide the community consultation process. Participants should be instructed to thoroughly record the results from the field activity.
Activity 1.2. Field work in groups to collect data
⌚ 1-2 hours <ul style="list-style-type: none"> Each group can work with a group of 3-4 community members (depending on the number of community members who are willing to participate in this exercise). Where possible, a woman from Group 1 should form women-only group (composed of women and girls) to collect information for gender analysis. Using the provided hand-outs (tools), participants collect information from communities and prepare a synthesis using a flip chart paper (and map for community mapping group)
Activity 1.3. Presentation of findings and briefing with the community
⌚ 1-2 hours <ul style="list-style-type: none"> A representative of each group presents key findings in front of the other groups and community. After each presentation, community members could be encouraged to reflect on the presented findings.
Activity 1.4. Participatory adaptation planning: developing potential impact pathways and a long list of adaptation options
⌚ 2 hours <ul style="list-style-type: none"> Facilitator presents to course participants and the selected community likely changes in future climate and briefs on what is Potential Impact Pathways tool Participants and community members are then divided into small groups and asked to draw Potential Impact Pathways graph, and list potential adaptation options. Next, the results of each group are presented, summarized and discussed. Outcome: clear potential impact pathway for the selected community and a long list of adaptation options.

Activity 2: Vulnerability assessment - synthesis and analysis of field exercise and secondary data (lab analysis)

Process and methods
Activity 2.1. Synthesis of field exercise findings and use of secondary data to complement township profile
⌚ 1-2 hours
<ul style="list-style-type: none">• Each group, as divided during the field work, should develop brief summaries of findings (if possible using computers)• Group 2 (socio-economic analysis) could use secondary data and graphs to show population data disaggregated by sex and age, level of education completed, income per capita, and employment rate.• Group 3 (spatial analysis and infrastructure) could use secondary data and graphs to show type of housing units, household access to drinking and irrigation water.• Outcome of Activity 2.1: completed profile of the case study and synthesis of information necessary to conduct vulnerability analysis.
Activity 2.2. Assessing current vulnerability to climate change and hazards
⌚ 2 hours
<ul style="list-style-type: none">• Considering the synthesis information prepared by each group, ask participants to discuss (in plenary) and come up with a list of observed/perceived by climate changes as stated by community members.• The analysis could be enriched by providing information to participants on regional observations (this can be extracted from Annex I).• Participants are then asked to discuss in groups and plenary, which are the most vulnerable sectors and groups.• The next step is developing a vulnerability index for the case study. The index computation could be done in small groups so that all participants can apply this methodology. Tool 8 will guide participants.
Note: The objective of this exercise is to teach participants on how to develop a vulnerability index. In practice, however, vulnerability indices are used for a comparison. For instance, in the presented case study of Labutta Township, vulnerability indices were computed for all village tracts. This enabled the vulnerability assessment team to identify most at-risk villages.
Activity 2.3. Assessing future climate change risk and scenario development
⌚ 2 hours
<ul style="list-style-type: none">• Place the Potential Impact Pathway 2050 developed with the selected community on a wall so that everyone can see it. The graph will serve as a basis for a discussion on future climate risk.• Ask participants to discuss in groups and in plenary future climate risk using the graph as a starting point but considering the community profile and current vulnerabilities identified during Activity 2.2. Make a reference to Annex II.• Next, in plenary discussion, participants should develop three scenarios: Business as usual, low investment (maintaining current living standard) and high investment (resilient development). More specifically, discussion should focus on required response and impact (consequences).• It is recommended that few participants support this process by recording and then summarizing the outcome of the discussion

Process and methods**Activity 2.4. Developing a long list of adaptation options**

⌚ 1-2 hours

- Divide participants into three groups based upon their sectoral expertise as follows:
 - Environment and ecosystems including agriculture (fisheries, livestock and crops production), forestry, water, other ecosystems and tourism
 - Socio-economic sectors
 - Infrastructure, connectivity and human settlements
- Ask them to develop a long list of CCA options (to be prioritized during the practical exercise of Module 4). Make a reference to Annex II and the suggestions provided by the selected community during the field visit.

MODULE 4

PREPARING LOCAL CLIMATE RESILIENCE ACTION PLANS

Session 4.1 : Preparing local climate resilience action plans: process and methods

Introduction to the session

Duration : 90 minutes (two blocks of 45 minutes)

Training methods : Lecture and case studies presentation, discussion in groups

Materials required : Projector, screen, PowerPoint slides and notes

This session introduces the process, methodology and tools for developing local resilience action plans based upon vulnerability assessment results and a long list of adaptation measures. At the end of the session participants will know the objectives, principles, process and methods for preparing strategic action plan, and be theoretically prepared for a practical exercise (covered in the next session).

Key points covered: purpose, objectives and key principles of local climate resilience action plans; developing an action plan based upon vulnerability assessment results; prioritization of adaptation options

Training content

What is a Local Climate Resilience Action Plan?

A Local Climate Resilience Action Plan is a policy document that outlines key climate change issues, strategic adaptation objectives, and specific actions to be implemented in a short-term (one to two years), medium-term (three to five years), and long-term (six plus years). Overall, such plans aim to direct national and local governments, development partners, as well as the private sector, civil society and individuals to invest in a climate-resilient and low-carbon development pathway to secure inclusive and sustainable development (MN-REC, 2017).

Climate Change Adaptation in Myanmar

Objectives:

- To reduce vulnerability to the impacts of climate change, by building adaptive capacity and resilience²³;
- To facilitate the integration of CCA and DRR in a coherent manner into township development planning processes and strategies, within all relevant sectors and at different levels.

Key principles:

Local climate resilience action plans should be strategic and inclusive, and follow a participatory, gender-sensitive and integrated approach to planning and implementation.

- *Strategic planning*

Setting optimal short-, medium- and long-term goals, objectives and specific actions, given the capacities and resources available.

- *Participatory CCA planning process*

Ensuring that relevant stakeholders take part in the planning process would allow for developing adaptation objectives built upon robust understanding of the needs, capacities and values of local communities and different social groups.

- *Gender-sensitive approach to climate resilience planning and implementation ('Do no harm')*

Gender sensitive policy, program, administrative and financial activities, and organizational procedures should:

- differentiate between the capacities, needs and priorities of women and men;
- ensure that the views and ideas of both women and men are taken seriously;
- consider the implications of decisions for women and men;
- take actions to address inequalities or imbalance between women and men.

... so that both men and women can equally benefit.

- *Integrated approach to implementation*

Local climate resilience action plans are integrated into existing township plans (including budgets), strategies and processes, through mainstreaming CCA (and DRR) measures into multiple sectors.

How to prepare a Local Climate Resilience Action Plan based upon vulnerability assessment results?

Through series of consultative meetings with a wide range of stakeholders and/or separate consultations with vulnerable communities, township officials can undertake strategic planning exercises to prepare local climate resilience action plan. Key steps of the planning process are discussed below (see Figure 26).



²³ Least Developed Countries Expert Group, 2012. National Adaptation Plans. Technical guidelines for the national adaptation plan process. Bonn: UNFCCC secretariat. Bonn, Germany. December 2012. Available at <<http://unfccc.int/NAP>>.

How to identify relevant stakeholders?

Engaging relevant stakeholders is critical for a successful CCA planning process. Therefore, township officials (CCA planning team) should develop a list of potential stakeholders (Table 7).

Table 7 : List of potential stakeholders²⁴

Guiding question	Potential stakeholders
Who should be included because of relevant government position?	National, regional and township government officials from multiple sectors who has expertise and decision-making power
Who should be included because of their control over relevant resources?	International organizations (governmental and non-governmental) and local non-governmental organizations can provide expertise and financial support
Who can support the implementation of the CCA action plan?	The private sector such as local businesses and industries Financial institutions Local media Research institutions and academia
Who can represent the needs of the most vulnerable, and contribute to the successful implementation of the CCA action plan?	Representatives of civil society organizations such as local labour and women's organizations/groups, organizations of persons with disabilities, local youth groups, farmers' associations, others Community leaders and individuals who can represent the interests of the most vulnerable communities and groups (e.g. residents of a settlement located in a flood-prone area, fishermen and farmers, small-scale producers, etc.)

STEP 1 Defining key issues in township based upon vulnerability assessment results and SWOT analysis

Example: Key issues identified for Labutta Township

Ecosystem issues:

- Deforestation of mangroves increases exposure to storm surges and erosion
- Seawater infiltration increases salinization of water impacting nutrient cycling in soil
- Shorter monsoon season and higher temperatures resulting in water shortage for agriculture and drinking

Socio-economic issues:

- Stronger storms, winds and unusually heavy rainfall destroys crops and cause frequent floods
- Shorter monsoon season and higher temperatures decrease crop production and increase livestock death
- Seawater infiltration increases salinization of soil and water resulting in lower rice crop yield
- Depletion of mangrove and over fishing has resulted in decline in fishery livelihood for coastal communities.

Infrastructure issues:

- Stronger storms, winds and unusually heavy rainfall affects people's mobility and access to cyclone shelters and basic services
- Shorter monsoon season and higher temperatures give less time to collect rain water and increase evaporation
- Deforestation of mangroves for firewood and housing material increases exposure to storm surges and erosion

24 Modified from UN-Habitat (2014).

Climate Change Adaptation in Myanmar

- This step entails presenting a summary of key findings in the form of issues, i.e. concerns, problems and challenges that people in the township face, as well as opportunities they may have. The identified issues could be grouped into three categories: ecosystem, socio-economic and infrastructure, as shown in the example below.
- In addition, a SWOT analysis of each system could inform adaptation planning on opportunities and limitations for action.
 - *Strengths* relate to features of the township of interest that could be used to achieve adaptation objectives such as presence of/access to natural resources, and capacities (human, financial, technical).
 - *Weaknesses* point to township characteristics that could limit CCA such as lack of technical knowledge and financing, poverty, inadequate infrastructure and environmental deterioration.
 - *Opportunities* relate to environmental, socio-economic and infrastructure specifics of townships that create a ground for new developments such as potential for introduction of renewable energy, potential for creating jobs in the industry sector, or potential for forest restoration and conservation.
 - *Threats* are those factors that pose barriers to/or can undermine climate-resilient development such as change in land tenure system, large infrastructure investment risks, expansion of industries that harm the environment (e.g. coal production, logging).

STEP 2 Converting key issues into strategic objectives and specific actions

Considering the identified key issues, as well as the SWOT analysis findings, township officials should set clear strategic and specific objectives, and concrete actions. This would provide direction and focus for decision-making, help people create a vision for the future and identify actions to achieve it, and support monitoring and evaluation of CCA action plans. Below is described how to do that.

- Convert the identified key issues, now grouped in categories, into **3 strategic objectives** (which will correspond to **strategic outcomes of local climate resilience action plans**). See Figure 27 and the example below.

How to convert an issue into objective?

Converting an issue into objectives relate to expressing how you would like to address (manage, minimize or mitigate) the issue. This is done by combining an action verb that describes a direction of preference (e.g. “increase”, “reduce”, “maximize”), with a description of the subject (e.g. “reduce risk of coastal storm surges”, “improve soil quality” or “reduce farmer’s dependency on rice production”). (UN-Habitat, 2014)

- Set **specific objectives** under each strategic outcome by taking key issues and converting them into 2-3 specific objectives (which will correspond to the **expected results of a local climate resilience action plan**).

Example: Strategic and specific objectives identified for Labutta Township

Strategic objective 1: Maintain and enhance healthy ecosystem to support living standards

Specific objectives:

- Protect and extend Forestry coverage to reinstate 1980 levels
- Protect natural resources to support agriculture and fishery;
- Mitigate the salinization phenomenon through adaptive crops and regulating eco-system services;

Strategic objective 2: Enhance socio-economic conditions by diversifying production

Specific objectives:

- Learning new skills to increase employment opportunities in other sectors;
- Maintaining agriculture productivity through capacity-buildings, loans, cooperatives;
- Investing in new industries, such as manufacturing, small enterprise.

Strategic objective 3: Ensuring people of Labutta have access to resilient infrastructure to protect people and support development

Specific objectives:

- Increase coverage and dissemination of hazard-resistant infrastructure and preparedness;
- Increase safety of household, through public and private climate resilient architecture and planning, including through household level water harvesting capacities;
- Ensure connectivity is protected and enhanced, through resilient transport services.

- Propose concrete **actions** to achieve the specific objectives by referring to the long list of CCA options identified previously (and described in the vulnerability assessment report). These actions should be linked to each specific objective. In case actions from the long list remain not categorised, discuss whether objectives are still relevant and if further objectives are required. Eliminate options that are not feasible or realistic given the capacity of the selected township of interest. At the end of this step, a short-list of options should be identified/agreed upon.

To guide policymakers on the types of action, each group of adaptation options (ecosystems, infrastructure and connectivity, socio-economic systems) could be further categorized into type of activity: management, investment, capacity-building/awareness, research/analysis (and indicated by using different colours as shown in Figure 27). This categorization is used in the list of CCA options provided in Annex III.

Climate Change Adaptation in Myanmar

Outcome	Expected Result	Activities	Type
To protect and enhance environment so that it can continue supporting and improving the living standards of people in Laputta	ER1 Forestry coverage is restored (to 1980 levels), enhanced and protected so to continue providing services as protection from hazard, eco-system for biodiversity (fishery), construction materials, soil regulation	Protecting existing mangrove/forestry areas by enforcing laws and regulations on protected forestry areas Protecting existing mangrove/forestry areas by creating community awareness on the need to maintain forestry Enhancing and restoring mangrove/forestry coverage in areas exposed to natural hazards and in areas with soil regulation Enhancing access to renewable energy sources as cookstoves, Solar Power to reduce weight on mangrove Implementing Community Forestry (integrated Management and Livelihoods) to provide for construction,	Yellow
	ER2 Natural resources and in particular the soil and the sea/river biodiversity are protected and enhanced so to continue supporting agriculture, fishery and people	Enhancing knowledge and capacities for Sustainable Soil Management (sustainable organic fertilizer, rotational Testing integrated soil management techniques to maintain soil productivity/fertility, including in salt Raising awareness on sustainable fishery and illegal chemical fishery Enhancing and restoring mangroves to (re)create ecosystems for fishery	Green
	ER3 The salinization process effects are mitigated by means of adaptive crops, regulating services (mangroves), and infrastructure	Protecting paddy fields/fields from salinization by constructing small community embankments Protecting fields by constructing large embankments Protecting fields by constructing dykes systems Testing crops resistant to salt to maintain and increase agricultural productivity Enhancing forestry and mangroves to control salinization Changing to livestock Training in agriculture adaptive techniques	Blue

Figure 27 : Example of strategic outcome, expected results and actions identified for Labutta Township

STEP 3 Prioritize actions

Criteria to assess and prioritize actions include:

Cost

- **Key question:** Can this township/community afford this option, and will it bring enough benefits relative to the cost of implementing it?

Feasibility

- **Key question:** Is the technology readily available and will the design, implementation and operation of the action be possible and within the capacity of communities and local government?

Community acceptability

- **Key question:** Would local people accept this action and have ownership of it?

Adaptation effectiveness

- **Key question:** How well would this action work in building resilience to climate change (relative to other options)?

Benefit anyway (no regret)

- Key question:** Would it bring other development benefits (e.g. raising income, improving education, delivering more services)?

Speed

- Key question:** Can the action be implemented in a short-term? Will it take long to bring adaptation benefits?

Suggested method

- Develop a table, which contains the identified in the previous steps Strategic Outcomes, Expected Results and Actions (short list of adaptation options) (see Figure 28).
- Discuss with stakeholders/community members and assess each action against the above criteria. Assign score to each action under each criterion (e.g. 1 – the lowest, and 5- the highest score). Higher score suggests higher priority. For instance, construction of cyclone shelter could have score 1, which indicates high cost that township may not be able to afford (Figure 28).
- Compute the total score for each action and rank all options.
- Review the results and ensure their accuracy.
- Discuss the strategic value of each option against the total score and make final selection of priority actions. For example, building cyclone shelter could have lower score due to the high cost of intervention. Nevertheless, it could be of strategic importance for community's resilience and hence prioritized (Figure 28).
- Verify if the prioritized actions address the most vulnerable sectors, locations and groups (women, children, other marginalized groups), identified through the vulnerability assessment.
- Develop a final list of CCA actions based upon the prioritization exercise.

Result	Action	Category	Cost	Feasibility	Community acceptance	Adaptation effectiveness	Benefit anyway (no regret)	Speed	Score	Strategy
All people in Labutta are protected to natural hazards	Participatory planning (Disaster Preparedness, Disaster Sen		5	5	5	5	5	5	30	100
	Disaster drills in schools		5	5	5	5	5	5	30	100
	Improve radio access and broadcast		5	5	5	5	5	5	30	100
	Flood maps at village tract/urban ward level		5	5	5	5	5	5	30	100
	Early warning system		5	5	5	5	5	5	30	100
	Hospitals and health post safety/security plans		5	5	5	5	5	5	30	100
	Emergency preparedness		4	5	5	5	5	5	29	100
	Sand Banks for protection in coastal areas		3	4	5	5	5	4	26	50
	Local material shelter		2	5	5	5	5	3	25	75
	Other small infrastructure resilient to hazards		2	3	5	5	5	3	23	75
	Evacuation routes		2	3	5	5	5	3	23	75
	Flood and erosion control plans		2	3	5	5	5	2	22	50
	Building cyclone shelters than can also be used as schools/community centres (local materials, double-use etc.)		1	2	5	5	5	1	19	75

Figure 28 : Prioritized adaptation options for Labutta Township under Strategic Outcome 3 Infrastructure
(Source: UN-Habitat/MCCA)

Integrating CCA and DRR at a local level

There are major barriers to the integration of CCA and DRR at a national and sub-national levels, which could limit the planning and implementation of local resilience action plans, such as:

- Need of coherent policy, regulatory and institutional frameworks and mechanisms at a national and sub-national levels.
- Need of institutional arrangements for resource mobilization (human and financial resources) for joint CCA and DRR activities that fall under local climate resilience action plans.
- Most often, changing disaster risk and uncertainties associated with climate change are not accounted for during DRM/DRR planning. In contrast, CCA foresees to reduce vulnerability to future risks.

The following recommendations can support local governments in overcoming the above barriers:

- First, strengthen collaboration between diverse stakeholders working on DRR and CCA at a local level. Engage them in the planning, implementation and monitoring process. Define clear roles, institutional arrangements and finance strategy for the implementation of local resilience action plans by engaging DRR authorities.
- Second, when developing local resilience action plans, take into consideration implementation priorities of existing local DRM/DRR plans. Find synergies (e.g. objectives and specific actions targeting climate-related disasters), and ensure that: (i) objectives of DRM plans and local resilience action plans are not contradicting; (ii) specific actions are coherent and aim at achieving common goal. Remember, when a township has a DRM/DRR plan, this makes it less vulnerable (because this suggests higher capacity of the township to face disasters), and hence supports the resilience-building efforts. Therefore, developing DRM/DRR plans could be viewed as a specific action under local resilience plans. This in turn opens more opportunities for funding DRR activities listed in climate resilience plans.
- Third, raise awareness of DRR authorities on the need of integrating changing disaster risk and uncertainties into DRR/DRM planning. For instance, promote the use of climate change data in disaster risk assessments, and strengthen the collaboration between DRR and CCA authorities (including hydro-meteorological institutions) for knowledge and information sharing.

Structure and content of a Local Climate Resilience Action Plan

Once the priority actions have been identified, township officials can develop climate resilience plan (Table 8). Based upon vulnerability assessment results and strategic planning exercise, the plan should also be linked to a selected scenario for 2050 (e.g. business as usual, low investment or high investment) (see Module 3).

Table 8 Suggested structure and content of a Local Climate Resilience Action Plan

Section	Content
Executive summary	Brief overview of purpose, objectives and key issues
1. Introduction	The introductory chapter could set the background, purpose and objectives, as well as key principles. Brief outline of the strategic planning process could also be highlighted, including who was involved and how. Description of key agencies responsible for developing the plan could be added.
2. Township vulnerability profile	Summary of vulnerability assessment results and scenarios for 2050
3. Strategic vision	Overview of agreed Strategic Outcomes, Expected Results and Adaptation Actions. This section should make link to the selected scenario.
4. Action plan	The information in this chapter could be presented in the form of a table, which contains Strategic Outcomes, Expected Results, Adaptation Actions with Annual Targets, and respective Strategic Indicators for measuring results.

Section	Content
5. Implementation and monitoring	Overview of institutional arrangements for implementation and monitoring Description of the mechanism for monitoring, reviewing and updating the plan Finance strategy (i.e. how CCA activities will be financed) Communication and public awareness strategy (i.e. how activities and results will be communicated to the wider public and stakeholders)
Annexes	Any relevant information such as glossary of terms, list of implementing agencies, or the vulnerability assessment report

From adaptation planning to adaptation implementation

Building resilience to climate change and hazards requires comprehensive policy response and actions. Identified ecosystem, socio-economic and infrastructure strategic outcomes and specific actions can build resilience only if they are seen and implemented as a whole set of necessary measures. This means that diversifying local economy without rehabilitating infrastructure and protecting nature cannot make communities less vulnerable to climate change.

Vulnerability of townships, communities and individuals is changing over time. Therefore, planned adaptation actions should be revised and updated at least every five years (including re-examining vulnerability assessment studies).

Engaging communities in implementation of CCA activities (and in maintenance of new or upgraded infrastructure) could: (i) reduce the cost of intervention; (ii) increase the sense of ownership of communities; and (iii) strengthen their knowledge and skills on how to cope and adapt to changing conditions.

Financing adaptation is often challenging. However, there are many low-cost solutions, particularly for community-based adaptation that should be explored when planning and implementing adaptation measures. Some examples: use of traditional knowledge, and those practices and local materials suitable to build resilience of communities; raising awareness of communities on the importance of forests and supporting them to In addition, townships could consider the following financing options:

"In Myanmar, community initiatives supported by locally managed funds played a key role in responding to Cyclone Nargis, which devastated the country in 2008. Community savings groups were central to the collective rebuilding of houses during the post-disaster rehabilitation phase."

(IIED, 2013. Briefing Urban Series.)

- International climate finance mechanisms and development donors: in collaboration with national government and international partners, local governments can benefit from the Adaptation Fund, the Global Environment Facility, the Green Climate Fund, and the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts; or seek financing from various bilateral and multilateral donors.
- National and local budgets: setting annual budget allocations for planned adaptation.
- Attracting direct investments in township resilience projects such as new green industries, which could reduce dependency on agriculture while creating jobs; or renewable energy projects that could limit deforestation practices.
- Promoting public-private partnerships in various sectors such as communications, insurance, transportation.
- Community level opportunities such as community savings groups and locally managed funds; and improved access to small credit and microfinance for community adaptation plans and hazard risk transfer.

Session 4.2 : Strategic planning exercise

Introduction to the session

- Duration** : approximately 1 day /about 6 blocks of 45 minutes/
- Training methods** : On-the-job exercise including group discussions and presentations
- Materials required** : Projector, screen, PowerPoint slides and notes, computers and printer (if available), flip chart and paper, markers, sticky notes, note cards, tape, hand-outs (annex V – V.5)

The activities in this session will give participants an opportunity to apply the knowledge they have gained from session 4.1 and develop a CCA action plan based upon vulnerability assessment results.

Activities

Activities and methods
<p>Activity 1. Defining key issues in township based upon vulnerability assessment results and SWOT analysis</p> <p>⌚ 1-2 hours</p> <ul style="list-style-type: none">■ Start this activity with an overview of findings from the vulnerability assessment.■ Divide participants into three groups (as in Activity 2.4/Session 3.2):<ul style="list-style-type: none">• Environment and ecosystems including agriculture (fisheries, livestock and crops production), forestry, water, other ecosystems and tourism• Socio-economic sectors• Infrastructure, connectivity and human settlements■ Ask them to identify key issues in their area of expertise based upon the vulnerability assessment results.■ In addition, each thematic group should conduct a SWOT analysis.■ Each group should record findings and present them to the large group.■ Facilitators of this exercise should note which of the suggestions from participants are correctly categorized as issues and explain why.
<p>Activity 2. Converting key issues into strategic objectives and specific actions</p> <p>⌚ 1-2 hours</p> <ul style="list-style-type: none">■ Each thematic group should convert issues into objectives, writing each on a note card.■ Ask groups to review their thematic objectives and to organize them into higher and lower levels.■ Having clear hierarchy of objectives, ask each thematic group (ecosystem, socio-economic and infrastructure) to agree upon one main strategic objective and 2-3 specific objectives.■ In the next step, groups should identify short list of adaptation actions by referring to the long list of CCA options identified previously (during vulnerability assessment exercise). These actions should be linked to each specific objective. Different colours sticky notes could be used to indicate the type of activity (management, investment, capacity-building/awareness, research/analysis).■ Facilitators of this exercise should note which of the suggestions from participants are correct.

Activities and methods
<ul style="list-style-type: none"> ■ When each group have identified 1 strategic objective, 2-3 specific objectives and short list of adaptation options, these should be presented in plenary to the large group. ■ Based upon outcomes of group work, Facilitator draws a master table, which contains the strategic objectives (corresponding to Strategic Outcomes), specific objectives (corresponding to Expected Results) and Actions identified from the three thematic groups.

Activity 3. Prioritize CCA actions

⌚ 1-2 hours

- Ask the thematic groups to assess each action (under their thematic objective) against prioritization criteria by assigning score from 1 to 5, whereas score 5 indicate the highest priority.
- Then, instruct groups to: compute total score for each adaptation action; rank all options; and review the results to ensure their accuracy.
- Results of each group are then presented and drawn on the master table.
- All participants in plenary review and discuss the results, including the strategic value of each option against the total score, and make final selection of priority actions.
- Lastly, participants prepare a final list of CCA actions based upon the prioritization exercise.

Note: If time and computers are available, participants could be divided into small groups and tasked to develop sections of the CCA plan for the selected case study, including summary of vulnerability assessment findings.

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Annexes

Annex I : Climate change in Myanmar: key indicators, observed trends and future projections

Note: the information in this section is summarized from: Horton R. et al., 2016; MNREC, 2017; MNREC, 2012(b). (see the previous References section)

I.1 Climate change indicators: observed and projected trends, and vulnerable regions

Climate change and hazard	Vulnerable regions
Climate change indicators:	<ul style="list-style-type: none"> • All regions
<ul style="list-style-type: none"> • Increasing mean seasonal and annual temperatures • Increase in daily maximum temperatures and number of hot days, more frequent heat waves • Shorter monsoons • Erratic rainfall patterns – increasing rainfall intensity (especially during the wet season) and decreasing number of rainy days 	
Drought, extreme high temperature/heat waves	<ul style="list-style-type: none"> • Arid and semi-arid central belt of the country • The Central Dry Zone
Intense rains, river and flash floods	<ul style="list-style-type: none"> • The Northern Hilly Region, mountainous and hilly areas in Kayin, Kachin, Shan, Mon and Chin states • The Central Dry Zone • The Ayeyawady Delta and low-lying coastal areas • Upper reaches of river systems and low-lying areas along major river systems
Sea level rise and increasing risk of coastal hazards (flooding, storm surges, strong winds, cyclones)	<ul style="list-style-type: none"> • Coastal areas mainly Rakhine State, the Ayeyawady Delta, and Mon State

I.2 Observed increase per decade in daily average temperatures, daily maximum temperatures, and precipitation over the period 1981 to 2010

	Temperatures	Maximum temperatures	Precipitation
Myanmar (average)	0.25°C	0.40°C	
Inland areas	0.35°C	0.57°C	2.5%
Coastal areas	0.14°C	0.23°C	4.5%

Climate Change Adaptation in Myanmar

I.3 Projected increase in mean annual temperature in 2011-2040 and 2041-2070 compared to the 1980-2005 average

Region	2011-2040		2041-2070	
Myanmar (All Regions)	0.7°C	to 1.1°C	1.3°C	to 2.7°C
Ayeyawady Delta	0.5°C	to 0.9°C	1.1°C	to 2.1°C
Central Dry Zone	0.7°C	to 1.1°C	1.2°C	to 2.7°C
Northern Hilly	0.7°C	to 1.2°C	1.4°C	to 2.8°C
Rakhine Coastal	0.7°C	to 0.9°C	1.2°C	to 2.4°C
Eastern Hilly	0.7°C	to 1.2°C	1.4°C	to 2.8°C
Southern Coastal	0.6°C	to 1.0°C	1.1°C	to 2.4°C
Yangon Deltaic	0.6°C	to 1.0°C	1.2°C	to 2.4°C
Southern Interior	0.7°C	to 1.1°C	1.3°C	to 2.6°C

I.4 Projected change in mean annual precipitation in the 2011-2040 and 2041-2070 compared to the 1980-2005 average

Region	2011-2040		2041-2070	
Myanmar (All Regions)	+1%	to +11%	+6%	to +23%
Ayeyawady Delta	-1%	to +11%	+3%	to +23%
Central Dry Zone	+2%	to +11%	+8%	to +22%
Northern Hilly	+2%	to +13%	+7%	to +27%
Rakhine Coastal	0%	to +9%	+5%	to +20%
Eastern Hilly	0%	to +10%	+7%	to +24%
Southern Coastal	-1%	to +8%	+3%	to +16%
Yangon Deltaic	0%	to +12%	+5%	to +24%
Southern Interior	+1%	to +11%	+7%	to +25%

I.5 Projections of sea level rise above 2000-2004 base period levels in Myanmar

Timeline	Sea level rise
2020s	5 cm to 13 cm
2050s	20 cm to 41 cm
2080s	37 cm to 83 cm

Annex II : Potential climate change impacts

Projected climatic changes and potential hazards	Potential impacts		
	Agriculture, natural resources and ecosystem services	Human settlements, industry and infrastructure	Human health, well-being and security
Increase in average temperatures, extreme heat events and droughts, changing/ shifting rainfall patterns	<p>Direct impacts on crop productivity, especially in rain-fed areas</p> <p>Direct impacts to rain-fed rice production</p> <p>Increased incidences of plant pests and diseases</p> <p>Livestock health deterioration or death due to feed and water shortages, heat stress, and animal diseases</p> <p>Increased aridity and soil moisture loss due to evaporation, resulting in reduced productivity and erosion</p> <p>Increase in demand for irrigation (resulting in increasing pressure on water and land resources)</p> <p>Reduced water for irrigation due to decrease in water flows and increased evaporation</p> <p>Reduced ground- and surface water availability</p> <p>Increased risk of forest fires</p> <p>Increased concentration of dissolved salts in the water due to evaporation</p> <p>Increased salinity concentrations in some aquifers, further limiting water availability</p> <p>Increased soil alkalinity primarily caused by using saline groundwater for irrigation, in turn reducing productivity</p> <p>Alteration of river flow, and consequent impacts to freshwater biodiversity</p> <p>Reduced nutrient and sediment deposition, which maintains healthy soils and provides nutrients to aquatic ecosystems and mangrove systems</p> <p>Reduced flood water retention, resulting from reduced soil moisture</p> <p>Ecosystem productivity declines as water availability for vegetation growth decreases</p> <p>Decline in marine biodiversity, caused by oceanic warming and acidification</p>	<p>Heat waves and urban heat island effect</p> <p>Disruptions to hydropower supply (consequent increase in wood harvesting)</p> <p>Increase in energy demand for cooling</p> <p>Increased water shortages in urban areas</p> <p>Higher air pollution levels in urban areas</p> <p>Reduced water availability for drinking and sanitation</p> <p>Impacts on local industries such as higher input prices (e.g. water, energy) and health decline of workers</p>	<p>Health risks as result of heat stress and dehydration, especially to elderly and pregnant women</p> <p>Cardiovascular system illness</p> <p>Emerging health risks due to reduced water availability for drinking and sanitation</p> <p>Disruption of school process due to heat waves or severe droughts</p>

Climate Change Adaptation in Myanmar

Intense rainfall and floods	<p>Damage to crops due to severe inundation of land</p> <p>Flash floods, intense surface run-off and soil erosion, resulting in damage of crops</p> <p>Waterlogging and washing away of top soil and nutrients, resulting in decline of crop productivity</p> <p>Increased risk of landslides, resulting in destruction of agricultural lands</p> <p>Direct loss of seeds and grain stocks</p> <p>Direct loss of livestock</p> <p>Loss of vegetation as result of floods and landslides</p> <p>Contamination of water resources due to river and flash floods</p> <p>Decreased groundwater flow and recharge, as most flows run-off downstream rather than recharging local aquifers</p>	<p>River floods, flash floods, and urban flooding, with direct loss of assets, houses and urban infrastructure</p> <p>Disturbance to river systems, making them more frequently impassable</p> <p>Destruction of roads and harbours/port facilities due to landslides in riverbank areas</p> <p>Siltation and sedimentation of waterways and dams, due to large-scale erosion processes</p> <p>Reduced water storage capacity of dams, as well as structural damages</p> <p>Damage to water storage and distribution facilities and infrastructure</p> <p>Damage to water infrastructure such as pumps, shallow dug wells and tube wells, irrigation systems, and storage ponds</p>	<p>Still water after flooding events conditions rise in vector-borne diseases such as malaria, filarial, dengue and other pathogens</p> <p>Rise in water-borne diseases such as diarrhoea, cholera and poisoning caused by biological and chemical contaminants in water</p> <p>Lack of clean water for drinking and sanitation and health consequences</p> <p>Affected/destroyed school buildings</p> <p>Decreased access to schools (e.g. blocked or destroyed roads)</p>
Cyclones, strong winds	<p>Direct loss of crops</p> <p>Direct loss of seed and grain stocks</p> <p>Soil erosion due to removal of surface layer of soils, resulting in decline of agricultural productivity</p> <p>Loss of coastal ecosystems due to strong cyclone, and consequent decline of fish and shrimp stocks</p> <p>Direct loss of livestock</p> <p>Direct loss of trees and plants</p>	<p>Damage to energy infrastructure (e.g. dams, electricity grid, gas pipelines, solar panels of households, etc.)</p> <p>Damage to water storage and distribution facilities and infrastructure</p> <p>Damage to water infrastructure such as pumps, shallow dug wells and tube wells, irrigation systems, and storage ponds</p> <p>Damages to road infrastructure, including bridges</p> <p>Loss/damage of assets, houses and urban infrastructure</p> <p>Damaged schools and public health infrastructure due to cyclones</p> <p>Impacts on small-scale household production</p> <p>Damage to manufacturing and industrial facilities</p> <p>Direct loss of fishing boats</p> <p>Toxic spillage of hazardous materials, such as oil or gas</p>	<p>Injuries and illness, loss of lives</p> <p>Social and mental stress from disaster and displacement</p> <p>Heightened risks to health and life for pregnant women, children, elderly and sick people, who have limited mobility</p> <p>Lack of clean water for drinking and sanitation and health consequences</p> <p>Displacement of people and communities</p>

Sea level rise, coastal erosion and storm surge	<p>Permanent inundation of coastal areas, consequent loss of agricultural land</p> <p>Constraints to rice production due to salt water intrusion</p> <p>Soil salinization resulting in reduced crop productivity</p> <p>Intrusion of salt water into groundwater systems, impacting irrigated agriculture</p> <p>Large-scale saline intrusion from strong tidal and storm surges, leading to salinization of land and water resources</p> <p>Destruction of coastal ecosystems and riverbanks</p> <p>Coastal ecosystems degradation, resulting in a decline of fish and shrimp stocks</p> <p>Deterioration of marine and coastal ecosystems and ecosystem services</p>	<p>Loss of assets, and impacts on infrastructure due to coastal erosion and storm surges</p> <p>Loss of assets, houses, and urban infrastructure due to permanent coastal inundation</p> <p>Impacts on local industries</p>	<p>Lack of clean water for consumption</p> <p>Displacement, increasing number of landless people, migration</p> <p>Conflicts over land and use of natural resources</p> <p>Decline in connectivity in coastal areas and the delta due to permanent coastal inundation and hence:</p> <ul style="list-style-type: none"> • reduced access of small producers to markets and consequent loss of income • reduced access to work place, resulting in less job opportunities • reduced access to basic services such as hospitals, schools and shelters
Climate change - secondary and long-term consequences	<p>Reduced agricultural productivity in a long-term</p> <p>Increasing human pressure on water, land and forest resources</p> <p>Lower productivity of ecosystems, resulting in decline of yield in agriculture and fisheries</p> <p>Desertification (resulting e.g. from intense rains following lengthier dry periods, which increases run-off rate and soil erosion; deforestation and heat stress)</p> <p>Loss of tree and plant species, and in turn reducing carbon storage and sequestration capacity</p>	<p>Higher prices of manufactured goods</p> <p>Disruption of trade and consequent loss of income</p> <p>Impacts on small-scale household production, such as textiles</p> <p>Increased maintenance and operational costs of dams</p> <p>Reduced access to water and hydropower energy especially in urban areas</p>	<p>Decreased household incomes and consequent food and income insecurity, and limited ability of families to cover school costs (leading to a decline in literacy rates)</p> <p>Low or negative economic growth, unemployment and migration</p> <p>Conflicts over land and use of natural resources</p> <p>Higher food, water and energy prices and consequent rise in the number of food, water and energy insecure households</p> <p>Loss of food and income security assets for rural households</p> <p>Health decline as result of high air and water pollution (e.g. respiratory ailments), reduced access to drinking water and food (malnutrition)</p>

Annex III : Long list of local climate change adaptation options

This long list of adaptation measures aims at informing and guiding national and local policymakers on opportunities to adapt to changing climate patterns. The document is developed in compliance with the sectoral objectives postulated in MCCSAP, and based upon:

- National priorities identified in key sectoral policy documents, including the national climate change policy framework;
- Consultations with national government officials²⁵;
- Local level consultations in Pakokku and Labutta townships, where MCCA Team has led the development of township climate resilience plans (and climate change vulnerability assessment studies);
- Literature review (references are provided below the table).

The following sectors are captured: (i) agriculture and food security; (ii) environment, ecosystems and tourism; (iii) energy, transport and industry sectors; (iv) human settlements and the built environment; (v) DRR, health and social inclusion; (vi) education and public awareness. In addition, to guide policymakers on the priorities for action identified through the vulnerability assessment method presented in this book, each adaptation option is categorized as follows: area of action (ecosystems, infrastructure and connectivity, socio-economic systems), and type of activity (management, investment, capacity-building/awareness, research/analysis).

III. 1 Agriculture Sector (including crops, fisheries and livestock sub-sectors) and Food Security

	Proposed adaptation measures	Area of action/ type of activity
Crop production	<p>Improved soil management:</p> <ul style="list-style-type: none"> • Promoting conservation tillage techniques (e.g. no-tillage and use of residue to preserve soil moisture and prevent soil erosion). This technique might not be suitable for all types of crops. • Applying integrated nutrient management (balanced and optimal use of organic and mineral nutrients). This technique requires prior soil and plant analysis to determine nutrient deficiencies. • Introducing inter-cropping and crop-rotation techniques (e.g. in fields used for cash crops) • Promoting organic farming • Windbreak trees prevent from soil erosion and offer additional benefits (e.g. shade and fodder for cattle) <p>Improved crop management and production:</p> <ul style="list-style-type: none"> • Promoting crop diversification (i.e. adding new/alternative crops to agricultural production) • Introducing new crop varieties resistant to environmental stress (e.g. flood-, drought-, heat- and salt-tolerant varieties; varieties with a shorter growing cycle) and improving the access of farmers to seeds. • Ecological pest management through integrated crop, soil and pest management • Improved storage of seeds and grain • Developing local risk maps for agriculture to support adaptation planning 	ecosystems/ management (and research)
		socio-economic/ management (and research)

25 The consultations took place in UN-Habitat/MCCA office on 13-14 February 2017.

Water management	<p>Climate-resilient infrastructure:</p> <ul style="list-style-type: none"> Introduction of sprinkler and drip irrigation (for dry areas, drip irrigation is considered more suitable than sprinkler), focusing also on small-scale community-managed irrigation schemes Rainwater harvesting (particularly suitable technology for areas where surface and groundwater resources are scarce) Improved irrigation canal and drainage systems (e.g. building dykes could help to drain away excess water and allow farmers more control over water levels in their fields) <p>Improved water-use management at the farm level through:</p> <ul style="list-style-type: none"> Establishing water user groups/committees Introducing alternate wetting and drying irrigation for rice (periodic drying and re-flooding of a rice field), which saves water and reduces greenhouse gas emissions while maintaining yields. Trainings on water management and maintenance of water infrastructure 	infrastructure/investment
Livestock	<ul style="list-style-type: none"> Selective breeding of animal species Planning for animal feed and pastures when rehabilitating degraded crop land Planning climate resilient water supply for livestock (water requirements, access points, etc.) Supporting farmers to build safe shelter for animals and storage of animal feed (disaster preparedness) 	socio-economic/management
Fisheries	<ul style="list-style-type: none"> Investing in community-scale aquaculture and building community capacity (e.g. provide training, support the formation of aquafarm management committee, support the selection of species that thrive in local conditions) Improve the access of fishermen to microfinance/loans (e.g. for buying fishing nets, boats) Raising awareness on sustainable fishing, as well as on illegal and chemical fishery (e.g. through workshops, fliers, signs and radio broadcasts) Develop fishing calendars and enforce laws/regulations 	socio-economic/investment ecosystems/management and capacity-building
Farming systems and household food security	<p>Diversifying farming systems by promoting:</p> <ul style="list-style-type: none"> Mixed farming (integrated crop and livestock farming system) Agroforestry practices (mixed farming of trees, non-tree crops and/or animals) Integrated farming by combining fishing, crops production, forestry and/or livestock (e.g. combining rice and fish farming) Household gardening to increase food security and diversify income 	socio-economic/management
Capacity-building	<ul style="list-style-type: none"> Improved capacities of townships and farmers to sustain agricultural production: Building technical capacities of townships for testing innovative, climate-resilient agricultural techniques and crop varieties Training of farmers on various climate-resilient practices, as well as on quality seed storage/preservation Training of farmers on how to develop seasonal crop calendars for changing hydro-meteorological patterns 	socio-economic/capacity-building

Climate Change Adaptation in Myanmar

	<ul style="list-style-type: none"> Promoting mechanized production by developing finance schemes for farmers and providing training on maintenance and operation Increasing the access of farmers to climate risk information (e.g. seasonal forecast), and raising climate change awareness of communities Forming cooperatives at the community level in agriculture, live-stock and fisheries sub-sectors for improved access of producers to markets and sustained natural resources utilization (e.g. by providing trainings and establishing clear rules/regulations) 	
Finance and insurance	<ul style="list-style-type: none"> Improving access of small producers to finance and insurance Investing in agriculture-related processing industries to create jobs and diversify local economy (based upon prior value-chain analysis) 	socio-economic/investment (and research)
Disaster risk reduction	<ul style="list-style-type: none"> Undertaking measures against floods and saltwater intrusion by engaging communities in implementation of activities, as well as providing trainings on maintenance. Those include building sandbanks or embankments, and planting mangroves (in coastal areas), among others. 	infrastructure/investment and management
	<ul style="list-style-type: none"> Increasing food storage and stockpiling capacities of communities Conduct capacity-building activities for establishment of community-run climate monitoring and disaster early warning system (e.g. for slow-onset disasters such as droughts, and rapid-onset disasters such as floods) 	socio-economic/capacity-building

III.2 Environment, ecosystems and tourism

	Proposed adaptation measures	Area of action/type of activity
Marine and coastal ecosystems	<p>Conservation and restoration of mangroves, which provide protection against climate hazards, as well as breeding and feeding grounds for fish and other aquatic species:</p> <ul style="list-style-type: none"> Adopt community-based approach to restoration, management and protection of mangrove forests. Raise awareness of local communities to prevent over-extraction, and promote sustainable forest use. Work with cooperatives for conservation. 	ecosystems/management and capacity-building
	<p>Strengthen policy and regulatory measures for protection of marine ecosystems:</p> <ul style="list-style-type: none"> Increase patrols and enforce laws/regulations to prevent cutting of mangroves, and illegal activities such as chemical and electric shock fishing, as well as overharvesting of fish stocks. Expand protected zones along the coast, and strengthen land tenure regulations to prevent land seizing from foreign and domestic developers. 	ecosystems/capacity-building

Inland water resources	<p>Promote health of rivers:</p> <ul style="list-style-type: none"> Enhance riverbank vegetation (e.g. trees plantation): reduces riverbank erosion, controls run-off, and protects communities against upstream flow regime variation, flash floods, sea level rise and storm surge. Restore ecosystem balance in lakes (e.g. Inle Lake) through conservation initiatives, control of pollution from agriculture, and awareness-raising of local communities. 	ecosystems/ management and capacity-building
	<p>Promote health of wetlands, which are important habitats for biodiversity and provide water purification and groundwater recharge services:</p> <ul style="list-style-type: none"> Control nutrient and fertilizer pollution from agricultural areas located upstream of the wetland by encouraging use of organic fertilizers. Enforce laws and regulations, and fence wetlands to prevent land encroachment and agricultural use during dry season. 	ecosystems/ management and capacity-building
	<p>Sustain quality and recharge of groundwater:</p> <ul style="list-style-type: none"> Conduct research on groundwater aquifers. Enhance forestry and vegetation cover to induce groundwater recharge. Introduce artificial recharging projects in over-exploited areas. Improve groundwater use efficiency. 	ecosystems/ research and management
	<p>Manage watersheds for water quality and quantity control:</p> <ul style="list-style-type: none"> Introduce integrated water resources management, i.e. managing water, land and related resources usually at a river basin scale. Such approach promotes the coordinated development and management of water and other resources to maximize the economic and social benefits without compromising the sustainability of vital ecosystems. Implement small-scale watershed management projects, which aim at reducing risks (e.g. improved storm water run-off from agricultural and urban areas) and enhancing health of ecosystems (such as to reduce pollution from various human activities, and to prevent deforestation and soil erosion). Implement reforestation projects and/or reduce upstream deforestation: This has a myriad of benefits, including preventing flash floods downstream by reducing storm water run-off from upstream areas, preventing landslides, replenishing groundwater supplies, and preventing erosion. Enhance forestry and mangroves downstream: This slows sea level rise and buffers storm surge, in turn preventing saline intrusion to ground- and surface water sources. 	ecosystems/ management

Climate Change Adaptation in Myanmar

Forests and mountain (hilly) regions	<p>Protect and enhance forests:</p> <ul style="list-style-type: none"> Promote community-based forestry. Increase electrification rate/provide alternative sources of energy such as solar power cook stoves, to reduce reliance on firewood and charcoal for energy generation. Adopt practices on sustainable management and conservation of forests, e.g. through REDD+ (Reducing Emissions from Deforestation and Degradation) projects. Enforce strict laws and regulations against illegal commercial logging, and conversion of forests to agricultural land, and unsustainable practices such as 'slash and burn'. Promote community-based wildfire management, e.g. establishing and training ranger groups. Reduce the erosion and landslide risk in unstable hillsides: various mitigation actions could be implemented such as shrubs/trees plantation, construction of drainage systems, and sustainable use of land for agriculture. 	ecosystems/management and capacity-building
Dryland	<ul style="list-style-type: none"> Enhance local level capacities to prevent occurrence of wildfires resulting from heat waves and droughts. Establish community-based wildfire management (e.g. ranger groups) Enhance forestry: in dry areas, this can provide a myriad of benefits including preventing soil erosion and retaining nutrients in soil, provide canopy cover, recharge groundwater, prevent flash floods and excessive sedimentation downstream. 	ecosystems / management
Tourism	<ul style="list-style-type: none"> Promote community-based ecotourism, which is "a form of eco-tourism where the local community has substantial control over, and involvement in, its development and management, and a major proportion of the benefits remain within the community."²⁶ Employ tourism as a tool to enhance management of protected areas, and alleviate environmental pressures from unsustainable forms of commercial agriculture. Conduct destination specific vulnerability assessments and adaptation strategies, and integration climate change knowledge into destination plans. 	ecosystems / management and research
Environmental monitoring for improved resilience	<ul style="list-style-type: none"> Improve monitoring of key environmental indicators at the local level such as climate parameters, soil properties, erosion and sedimentation, water quality, vegetation cover, health of forests. Specific actions could be focused on strengthening technical and human capacities of townships (e.g. delivering computers and creating monitoring database, trainings, etc.). Engage academia in developing environmental monitoring systems and conducting policy-oriented research. 	ecosystems/ capacity-building and research

26 The International Ecotourism Society (2006) Community-Based Ecotourism in Asia Pacific: Best Practice Stories and Resources

III.3 Energy, transport and industry sectors

	Proposed adaptation measures	Area of action/ type of activity
Energy	<p>Introduce new energy sources at the township level:</p> <ul style="list-style-type: none"> Provide solar panels on the village level to generate and distribute electricity to households. Construct new/renovate existing mini-scale hydropower dams: This is particularly well-suited for hilly and remote areas with abundant water resources, where the expansion of an electricity grid across the rugged terrain to distribute to a scattered population poses a challenge. This action can be implemented by communities. Where resources are available, introduce large energy infrastructure such as hydropower, wind and tidal energy. This involves studying suitable locations, considering environmental and social impacts, and installing facilities, infrastructure and a distribution system. 	infrastructure / management
	<p>Introduce diverse energy sources at the community/household level:</p> <ul style="list-style-type: none"> Introduce renewable energy to communities: for example, community kitchens, cook stoves and solar panels can improve access to energy in rural communities, and at the same time help to reduce greenhouse gas emissions by preventing deforestation for firewood. Conduct a willingness to pay survey that could help communities gain a sense of ownership Training should be provided so that the communities can adequately maintain and repair facilities. 	infrastructure/management and capacity-building
Transport	<p>Take a community-driven approach to upgrade road transportation and infrastructure: improving road and bridge infrastructure will improve access to markets and services for people in isolated communities, making them less vulnerable during and after extreme weather events.</p> <ul style="list-style-type: none"> Construct/restore bridges, renovate roads and footpaths. Construct and renovate culverts and course ways. Restore drainage systems to clear away culverts and sites of stagnant water from floods. 	infrastructure/management and research
	<p>Improve river transportation: With heavy rainfall and sea level rise hindering connectivity, improved water transport will enable people in rural areas to trade and access services more effectively, thus reducing their vulnerability.</p> <ul style="list-style-type: none"> Improve boat transport, including boat conditions and river routes. Plant riverbank vegetation to reduce the impacts of upstream flow regime variation, sea level rise and storm surge. 	infrastructure/management

Climate Change Adaptation in Myanmar

	<p>Introduce public transportation, to improve people's access to markets and services:</p> <ul style="list-style-type: none"> • Buses and mini-buses are affordable and easily implementable options which also create jobs. • Where there is need and resources are available, light rails might also be considered. 	infrastructure/ management
	<p>Adopt planning practices, including transportation planning:</p> <ul style="list-style-type: none"> • Adopt integrated spatial strategic planning: a coordinated effort to involve or integrate transport in the planning process, especially land-use planning, to reduce the costs of transportation. • For medium to large cities: develop a comprehensive urban transport plan. This can address, for example, strengthening road maintenance and improvement, public transport development and traffic management, in the short-, medium- and long-term. • Conduct risk assessments for high risk regions (e.g. sea level rise or landslide risk assessment). 	infrastructure, socio-economic/ management
Industries	<p>Build capacity of large-/medium scale enterprises:</p> <ul style="list-style-type: none"> • Awareness-raising in the private sector: companies should be informed on the climatic threats (e.g. implications of climate change for agricultural products and raw materials). • Encourage business planning with early climate change adaptive planning and investment (which will attract partnerships with foreign companies that do have a strategic long-term outlook). • Create enabling environment for investments in climate-/disaster-resilient and energy efficient production. 	socio-economic/ capacity-building and investment
	<p>Encourage and build capacity of Small and Medium Enterprises:</p> <ul style="list-style-type: none"> • Form microfinance organizations to provide loans for small medium enterprises: This would enable people to be less reliant on agriculture and increase their income in other sectors. • Provide/improve access to loans and necessary skills (training). • Provide capacity development to microfinance clients, institutions, regulators, investors and private banks. 	socio-economic/ capacity-building and investment

III.4 Human Settlements and the Built Environment

Proposed adaptation measures		Area of action/ type of activity
Housing	<p>Build resilience:</p> <ul style="list-style-type: none"> • Adopt disaster resilient design and building techniques: Provided adequate training on construction and maintenance, residents can build their homes themselves using local materials, and traditional building methods that are adapted and resilient to climate change impacts. • Use legislation to promote sustainable construction or other measures for the adoption of energy efficient and disaster resilient technologies (e.g. adopt the Myanmar National Building Code in building construction). 	infrastructure/ management and capacity-building

	<ul style="list-style-type: none"> Conduct study on willingness to pay for retrofitting: informs decision makers on how much people are willing and able to pay to upgrade their houses. This helps to plan for additional support needed for at-risk communities 	infrastructure/research
Infrastructure and basic services	<p>Improve water infrastructure and services:</p> <ul style="list-style-type: none"> Improve Water Capture and Storage: This involves: (i) conducting a study on water availability in different locations to determine design interventions (e.g. upgrading ponds or building new facilities such as gravity flow piped water system, wells with overhead tank in order to provide piped water with meter to households, spring source with catchment), (ii) working with communities to install the new facilities, and (iii) training local people on maintenance. Strategic Water Networking: This activity involves planning and designing water management systems through community consultations with the objective to improve distribution efficiency and ensure that people have access to water when they need it. Conjunctive use of surface water and groundwater: reliance on a single source for freshwater increases people's vulnerability to climate hazards such as flooding and droughts. Conduct Water Safety Planning to strengthen communities' capacities and capabilities for cost-effective management and maintenance of their water supply resources. 	infrastructure/management
	<p>Improve sanitation facilities :</p> <ul style="list-style-type: none"> Construct school sanitation with toilets and hand washing facilities. Build water storage facilities for schools in drought-prone regions. Construct and upgrade household latrines. 	infrastructure/management
	<p>Improve waste management: as with sanitation, this will reduce human health risks in the face of extreme weather events such as flooding and droughts.</p> <ul style="list-style-type: none"> Adopt integrated waste management and spatial planning. Select location not prone to hazards. Small-scale, regional landfill sites are less costly to construct and operate, and incur less transportation costs than large-scale landfills. Use the informal sector for waste collection: Employing informal waste pickers creates jobs, saves municipalities money and protects the environment. Introduce composting: an inexpensive process that can deal with as much as half of urban waste. 	infrastructure/management

Climate Change Adaptation in Myanmar

	<p>Adopt sustainable practices:</p> <ul style="list-style-type: none"> • Introduce Green Infrastructure: An urban environment designed with green infrastructure to reduce urban heat island effects is better positioned to manage current and future climate variability and change. • Implement Sustainable Urban Drainage Systems: this is a cost-effective natural approach to managing drainage. Main benefits include preventing water pollution, recharging groundwater to help prevent drought, and reducing the risk of flooding, among others. The different techniques include green roofs; filter strips and drains; permeable surfaces and swales; infiltration devices and basins and ponds. • Conduct a willingness to pay survey to inform decision makers on how much people are willing and able to pay to upgrade their basic services such as water and sanitation. This helps to plan what additional support is needed for at-risk communities. • Extend the reach of services to ensure that the poorest and remote communities are included. • Improve management of infrastructure through awareness-raising and capacity-building activities. For instance, communities could be trained on maintenance of community infrastructure. This is essential because future climate and urban population growth will create pressure on urban infrastructure. 	infrastructure, ecosystems/management and research
City and town planning	<ul style="list-style-type: none"> • Conduct local adaptation planning: develop hazard risk maps (e.g. landslide, sea level rise and flood risk assessments), conduct vulnerability analysis and prepare short- and long-term local adaptation plans. • Adopt climate-sensitive land-use planning which systemically considers locations, siting, and orientation of public buildings and settlements, and introduces mechanisms to integrate additional features resulting from changes in climate to plan for new infrastructure. • For coastal settlements: adopt coastal zone management that adequately prepares for sea level rise. • Adopt cross-sectoral planning and decision-making: the impacts of climate change cut across all urban sectors, and hence coordinated actions will reduce overlap or counteracting interventions and increase efficiency. 	all categories/capacity-building
Disaster risk reduction in urban areas	<ul style="list-style-type: none"> • Implement the Myanmar National Building Code, which regulates structural integrity for disaster resilience. <p>Implement capacity-building activities:</p> <ul style="list-style-type: none"> • Conduct disaster management course trainings for township officials. • Prepare a Township Disaster Management Plan. • Raise disaster risk awareness among communities. 	infrastructure/management socio-economic/capacity-building

	<p>Construct and upgrade hard infrastructure:</p> <ul style="list-style-type: none"> Small infrastructure to protect from hazards (cyclones, floods, heatwaves): select most vulnerable areas for construction, and work with local designers to ensure that houses can withstand floods, strong cyclones, etc. Involve local communities in constructing the houses, and train local people on maintenance. Build cyclone shelters than can also be used as schools/community centres: identify locations that lack both schools and cyclone shelters, and design a disaster resilient structure. Work with communities themselves to undertake construction, and to develop a local level plan to design escape routes. 	infrastructure/ management
	<p>Adopt ecosystem-based measures: communities can play a leading role in the design and implementation of these measures, and be trained to maintain the outcome.</p> <ul style="list-style-type: none"> Build bamboo river embankments, and other natural infrastructure: This can protect communities, fields and other assets from excess water, including salt water, as well as from flooding and erosion. Mangrove conservation and rehabilitation: in coastal areas mangrove forests serve as a natural buffer protecting communities from strong winds and storm surge, and preventing erosion of the coast. Sandbanks can be built and protected, especially together with mangroves, to protect coastal communities and agriculture from inundation. Ensure that work is done in conjunction with mangrove restoration. In mountainous areas, enhancing forestry can help prevent landslides during heavy rain events, and prevent flash floods downstream. 	infrastructure, ecosystems/ management

III.5 DRR, Health and Social Inclusion

	Proposed adaptation measures	Area of action/ type of activity
Health	<p>Improve access to health services, sanitation and hygiene, as well as information and knowledge on health risks related to climate change:</p> <ul style="list-style-type: none"> • Increase awareness of climate change and health: This will enable people to undertake actions by themselves that prevent injury and disease as result of climate hazards. Awareness-raising can be achieved through community-level workshops, schools and radio broadcasts, distribution of brochures, among others. • Provide decentralized health care services: Decentralized rural health care facilities could be established to ensure that all people have adequate access to healthcare, especially in rural areas where people are exposed to various climate hazards. For instance, provide mobile clinic services which have the capacity to treat diseases such as malaria, and train volunteers. • Adopt interventions centred on “Behaviour Change Communication” by implementing “Participatory Hygiene and Sanitation Transformation”, where communities themselves become responsible for promoting awareness and practice-improved hygiene behaviour. • Construct and upgrade water and sanitation infrastructure: • Improve drainage infrastructure to prevent water- and vector-borne diseases resulting from flooding. • Plant trees to provide canopy cover and reduce heat-related ailments. • Upgrade water infrastructure and services to prevent dehydration and water-borne diseases resulting from reduced water availability, or contaminated water supplies due to climate hazards such as flooding or droughts. • Ensure adequate waste management to reduce the risk of air-, water- and vector-borne diseases. 	socio-economic/ capacity-building and management
Disaster preparedness, early warning, response, recovery and reconstruction	<p>Improve housing construction to protect from floods and cyclones: Incorporating disaster risk reduction principles into housing construction will benefit people in flood and cyclone prone areas who experience frequent damage resulting from these hazards. This will reduce the risk of injury and death in extreme weather events.</p> <ul style="list-style-type: none"> • Develop early warning systems and evacuation routes: These will enable people to escape sudden, rapid-onset hazards such as cyclones and storm surges. • Improve radio access and broadcasts: This help people to be aware of climate change and impending severe events. Broadcast quality should also be improved to include relevant information. • Develop Flood and Erosion Control Plans: These would give the township the required knowledge to propose flood and erosion prevention and control measures to national government and external donors. 	socio-economic/ capacity-building and management

	<ul style="list-style-type: none"> Mobilize local volunteer groups to support disaster preparedness, early warning and early response activities, and provide necessary trainings. Promote establishment of community-run early warning systems. Adopt community-based projects for post-disaster reconstruction and rehabilitation of homes and community infrastructure, applying “Build Back Better” principles. Provide trainings to affected communities on how to build safe houses after disaster using local materials. 	
Social protection and inclusion	<p>Diversify livelihoods to reduce people's vulnerability: households relying solely on primary economic sectors such as agriculture and fisheries risk losing their livelihoods due to extreme weather events.</p> <ul style="list-style-type: none"> Provide more access to primary and secondary education. Provide vocational and skills training and apprenticeships, such as such as carpentry or computer skills. Target vulnerable groups such as people with disabilities and women heads of households. Establish microcredit cooperatives and savings groups. <p>Strengthen socio-economic safety nets:</p> <ul style="list-style-type: none"> Introduce job guarantee schemes: This will provide employment for people affected by disaster when other work may not be available. Involves identifying at risk population, finding labour sources and sponsoring their daily wages. Provide access to agricultural land for people who lost their land due to climate hazards such as sea level rise and erosion. 	socio-economic/capacity-building and investment
	<p>Involve children in decision-making and advocacy:</p> <ul style="list-style-type: none"> Children learn why climate change is occurring, the risks they face in their communities, and the actions they can take to become resilient. Encourage involvement of youth: Children and youth can get involved and take the lead in devising community action plans, as well as finding innovative solutions for adaptation. Leverage social media as a tool for communicating messages to youth about climate change that lead to increased awareness. 	socio-economic/capacity-building

III.6 Education and Awareness

	Proposed adaptation measures	Area of action/ type of activity
Public awareness	<p>Disseminate knowledge and information regarding climate change and its impacts to the public through various channels:</p> <ul style="list-style-type: none"> • Conduct radio and television broadcasts with relevant information, and manage social media sites (Facebook, Twitter etc.) to reach a broad target audience in disseminating relevant knowledge and information. • Conduct trainings and workshops on CCA targeting communities and civil society groups. • Work with volunteers to reach communities and vulnerable groups, and build their capacities through trainings. • Organize youth forums to discuss issues related to climate change. • Create appealing brochures, games, short videos and materials that share climate change messages. Engage communities and representatives of vulnerable groups in developing awareness-raising materials such as women, people with disabilities and children. • Raise awareness among children: work with teachers, school administrators and local departments of education to teach lessons about climate change in the classroom. • Use school and community events to raise awareness. For example, include climate change among the topics of open day events organized by local schools. • Engage (local) media such as newspapers to reflect various climate change events and activities organized in townships to raise awareness. • Integrate climate change into school curriculum. For example, organize planting trees in schools to raise awareness of children. 	socio-economic/ capacity-building
Climate-resilient and safe schools	<ul style="list-style-type: none"> • Plan for future climate risks when selecting sites for new school buildings (e.g. sea level rise projections; flood/landslide risk; connectivity under future climate). • Conduct risk assessments of local schools and undertake actions to make school buildings safe. • Build schools that have a double-use, e.g. as cyclone/heat-wave shelters or community centres, employing disaster-resilient design. • Build water storage facilities for schools in drought-prone regions. • Train teachers and school children on safety measures during disasters and climate extremes. • Integrate climate change into school curriculum. For example, organize planting trees by children to raise their awareness. • Improve access to information technology and communication devices such as radio, television, mobile phone, computer and internet to provide solutions to the frequent disruption of education due to extreme weather events. 	infrastructure/ management and capacity-building

III.7 Mainstreaming gender into CCA and DRR

Proposed adaptation measures	Area of action/ type of activity
<p>Economic empowerment of women:</p> <ul style="list-style-type: none"> Acknowledge women's contribution in the agriculture and fishing sector. Provide support and training to women so that they can gain new skills such as business development. Ensure equal access to credit and loans; give special attention to female-headed households. Develop policies that support decent work and entrepreneurship for women. 	socio-economic/ capacity-building and investment
<p>Promote women's participation and leadership:</p> <ul style="list-style-type: none"> Promote women's participation and leadership in natural resources management (e.g. water and forest). Promote women's participation and leadership in CCA in mixed groups. Raise awareness of communities on the importance of engaging women in CCA as they play a major role in the use of natural resources, securing food and income for family and contributing to community's development. Ensure active participation of women at all stages of local adaptation planning, including vulnerability assessment, local action planning activities, implementation) and monitoring and assurance of sustainability. Develop and distribute awareness-raising brochures to communities, which explain the relationship between gender roles and CCA planning and implementation. 	socio-economic/ awareness-raising
<p>Strengthen the capacities of women through knowledge building:</p> <ul style="list-style-type: none"> Strengthen disaster preparedness and response capacity of women, and improve their access to disaster prevention, preparedness and early warning information at the local level, targeting the most vulnerable women through trainings and awareness-raising activities. Develop and distribute gender-focused information materials and infographics (capturing CCA and DRR activities.), by engaging women in this process. Reduce women's unpaid workload through improved access to basic services (water, energy, sanitation) 	socio-economic/ capacity-building and awareness-raising
<ul style="list-style-type: none"> Introduce policies/measures that enable women to have improved access/control over productive resources such as land, seeds, irrigation, credits. Raise awareness on the gendered dimension of CCA and ensure capacity to implement gender-specific activities. Undertake outreach activities to ensure that different stakeholders understand the gender dynamics of climate change 	socio-economic/ management

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Annex IV Sample questions for exploring gender-differentiated vulnerability to climate variability and change in townships of Myanmar

Component of vulnerability analysis	Vulnerability assessment question	Vulnerability assessment question with gender consideration
Understanding livelihood to create community profile	What are the main work-related activities in your community?	<p>What kind of work men do? Is it paid? How much?</p> <p>What do women do, and are they paid? How much?</p> <p>The following aspects could be considered:</p> <ul style="list-style-type: none"> • Productive roles: paid work (e.g. agriculture, employment and other income-generating activities), subsistence production • Reproductive roles: domestic work (water, fuel, cooking, market), childcare and care of the sick and elderly • Community-related activities/duties
	What are the main livelihood assets available in your community?	<p>Who has access to these resources – both men and women? How and why?</p> <p>The following aspects could be considered:</p> <ul style="list-style-type: none"> • Human assets: such as health services, education, skills/training • Natural assets: land, water, forest, fish, key ecosystem service • Social assets: e.g. social networks, voluntary groups • Physical assets: housing and basic infrastructure (e.g. water, energy), transportation, communications • Financial assets: e.g. credit, loans, insurance
	Who takes the important decisions in community and has information on community life?	<p>What decision-making do men participate in?</p> <p>What decision-making do women participate in?</p> <p>Are women involved in community decision-making? If ‘no’, why? If ‘yes’ in what way? (e.g. decision on the management of resources and community planning process)</p> <p>Access to what kind of information do men have? And women? For example, do women receive information on important issues such as disaster-related information? If ‘no’, why? If ‘yes’ how and what kind of information?</p>
	If there is some development project to improve the life of community, usually, who benefits from this most?	<p>Are both women and men engaged in needs identification and implementation?</p> <p>Are women considered in benefit-sharing of a development project? If ‘no’, why? If ‘yes’ in what way?</p>

Assessing current vulnerability	Are seasons shifting and changing in other ways? Are these changes affecting your community and how?	Are there differences between men's and women's experiences of climatic changes? How and why? (e.g. health impacts, income impacts, access to water and sanitation, etc.)
	What happens when there is flood/drought? How is the community affected?	How are men affected? How are women and children affected? What men usually do in such case? What about women? What are their roles?
	What local solutions, resources and assets for coping with climate pressures are available? (e.g. natural and financial assets)	Who has access to these resources and assets? Who can cope better with climate change - women or men? How and why?
Assessing future vulnerability	What would happen in future when the local climate is getting warmer and sea level is rising?	How would this affect men? What about women? Why?
Identifying needs	Given the expected climate change, what are the needs of your community? What would help you to reduce the impact of climate change?	What do women need? What do men need? The following aspects could be considered: <ul style="list-style-type: none"> • Women's and men's needs to perform their productive and reproductive roles under the challenges of climate change • Long-term strategic perspective related to transformation of gender roles in family and community such as increased access to decision-making and resources

Note: This table does not contain exhaustive list of possible questions. Rather, it aims at guiding practitioners on how to structure their questions in order to collect gender-sensitive information through consultations with communities.

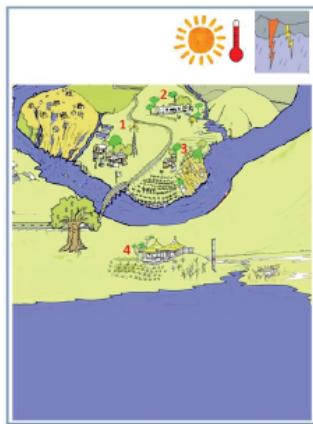
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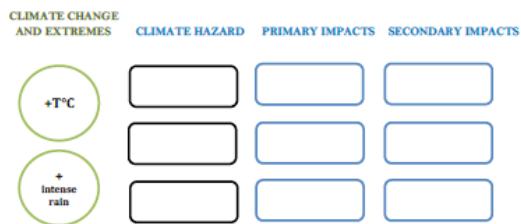
Annex V Hand-outs and tools for group exercises

V.1 Materials for group exercise: Module 1/Session 1.3

Material 1. Communities living along river



Material 2. Potential hazards and impacts of climate change



Material 3. Exposure, vulnerability and adaptive capacity

Exposure	Vulnerability	Adaptive capacity

V.2 Hand-outs for group activity: Module 2/Session 2.2

Module 2/Session 2.2

Group work: Climate change impacts on townships

The objective of this group activity is to identify climate change impacts on a selected township, and propose options for adaptation to achieve given adaptation objectives. The specific tasks are:

- **Task 1:** Select a township or area (region in the Central Dry Zone, Coastal Zone of Hilly Zone) that you already know well (for example your Township or region) and complete the following activities in about 20-25 minutes, using a flip chart to record key points:
 - List 5-6 key characteristics of the selected township/region, e.g. location along river or lake, high dependence on rice production, significant deforestation, high unemployment, etc.

- Using the information provided below, identify primary and secondary impacts of climate change, by drawing Potential Climate Change Impact Pathway for year 2050.

Steps to developing Potential Climate Change Impact Pathway for year 2050

1. Draw a Potential Climate Change Pathway for chosen township/region by selecting the most relevant to your case study potential hazards from the list below. These correspond to the climate change and hazards columns of the Potential Climate Change Pathway (see the sample below).

- Climate change projections 2050 (for all regions): increasing temperatures, increasing number of hot days, erratic rainfall (fewer rainy days but more intense rains)
- Potential hazards (specific to each region): heat waves, sea level rise (flooding/inundation, storm surges), strong winds, cyclones, drought, forest fires, erosion, landslides

Sample: Potential Climate Change Pathway

CLIMATE CHANGE AND EXTREMES	CLIMATE HAZARD	PRIMARY IMPACTS	SECONDARY IMPACTS

2. Identify possible primary and secondary impacts on the selected township/region, using arrows to show linkages. *Remember that some impacts could be a result of the combined effects of climate change and multiple hazards.* Think of the impact on ecosystems, socio-economic development and infrastructure, capturing various key sectors such as:

- Agriculture and food security (crops production, fisheries and livestock)
- Environment, natural resources and ecosystem services essential for communities
- Energy, transport and industry sectors, markets/trade and small-scale producers
- Cities, towns and human settlements
- Impacts of human health and vulnerable people (women, children, elderly, poor)

- Task 2:** Propose adaptation measures to reduce vulnerability and increase resilience. Use different colour cards/sticky notes to indicate the type of activity (management, investment, capacity-building/awareness, research/analysis). Place these cards on your flip chart (next to impacts column) and use arrows to show how the adaptation measure could reduce some of the identified impacts. You have 15-20 minutes to complete Task 2.

V.3 Participant guiding notes and tools for field exercise: Module 3/Session 3.2

Activities

Activity 1.1. Introduction to the field exercise

⌚ 30-45 minutes

- Form three groups. Each group will use two of the participatory tools for data collection presented in Session 3.1. The groups must have balance of men and women, and people with various backgrounds as suggested below. More specifically, the following groups could be formed:

- **Group 1: Ecosystems and agriculture group**

Suggested team composition: representatives from environment, forestry, water and agriculture sectors

Participatory tools to be used:

Tool 1 - group interview with community members with focus on ecosystems profile, observed climate changes and impacts on ecosystems and agriculture

Tool 5 – community seasonal calendar to identify observed climate changes and impacts on livelihood

- **Group 2: Socio-economic group**

Suggested team composition: representatives from socio-economic sectors (education, health, employment, economic development, etc.)

Participatory tools to be used:

Tool 2 - group interview with community members with focus on socio-economic profile, observed climate changes and socio-economic impacts

Tool 6 – focus group discussion with community members (women and girls) to explore gender roles and vulnerabilities

- **Group 3: Infrastructure and participatory mapping group**

Suggested team composition: representatives from relevant sectors, e.g. irrigation, water resources, rural development, DRM, other.

Participatory tool to be used:

Tool 3- group interview with community members with focus on infrastructure profile, observed climate changes and impacts on infrastructure

Tool 4 – participatory community and risk mapping

Activity 1.2. Field work in groups to collect data

⌚ 1-2 hours

- Each group can work with a group of 3-4 community members (depending on the number of community members who are willing to participate in this exercise). Where possible, a woman from Group 1 should form women-only group (composed of women and girls) to collect information for gender analysis.
- Using the provided hand-outs and corresponding tool, collect information from communities and prepare a synthesis using a flip chart paper (and map for community mapping group)
- Remember to record the information obtained from this field work!

Activity 1.3. Presentation of findings and briefing with the community

⌚ 1-2 hours

- A representative of each group presents key findings in front of the other groups and community. After the presentation, welcome comments from community members and record the provided feedback.

Activity 1.4. Participatory adaptation planning: developing potential impact pathways and a long list of adaptation options

⌚ 2 hours

- Facilitator will present likely changes in future climate in the case study region and will explain to community what is the Potential Impact Pathways tool (time: about 15 minutes)
- Then, each group should work with community members on developing Potential Impact Pathways graph, and a list of potential adaptation options (Tools 7 and 8) (time: about 1 hour)
- Upon completion of this task, a representative of each group presents key findings (about 30 minutes)
- The results of each group are then summarized and discussed to develop a clear potential impact pathway for the selected community and a long list of adaptation options. (time: about 30 minutes)

Tools

Tool 1: Group interview with community members with focus on ecosystems profile, observed climate changes and impacts on ecosystems and agriculture

What is a group interview?

A group interview is a type of semi-structured interview, which aims at obtaining community level information.

How to facilitate a semi-structured group interview?

- Prepare a list of key issues in advance and select one person from your group to lead the interview (nevertheless, the other group members can also ask questions)
- Use open-ended questions such as ‘what’, ‘why’, ‘who’, ‘when’ and ask for concrete examples; if you have questions arising from the given answers, ask new questions
- Try to involve everyone from the focus group to express opinion and share information
- Record the answers

What issues should be explored during the group interview?

The objective of the interview is to obtain information for developing the ecosystems component of the vulnerability analysis including ecosystems profile and impact of observed climate changes on ecosystems. Specific questions are suggested in the table below.

Climate Change Adaptation in Myanmar

Ecosystems profile	<p>What are the main natural assets available in your community?</p> <p>What is the state of these natural assets (level of environmental degradation and resource depletion)?</p> <p>Depending on the case study, the following natural resources should be explored:</p> <ul style="list-style-type: none">• marine and coastal ecosystems; coastal erosion and inundation• water resources and hydrology; seasonal variation in water availability (e.g. rivers, groundwater); water quality• forests and vegetation cover, and observed changes• soils and soil nutrient status• land use and drivers of change• biodiversity <p>Additional questions could be:</p> <p>What is the access of the community to water for drinking and irrigation, productive land (e.g. for agriculture and livestock), or marine resources?</p> <p>To what extent the community depends on natural resources for livelihood?</p> <p>Are there any environmental issues in this community such as erosion, deforestation, pollution of water resources (e.g. from agriculture), illegal fishing, expansion of agricultural land, 'slash-and-burn' practices?</p>
Impact of observed climate change on ecosystems	<p>Explore people's perception for changes in local climate. Some examples:</p> <ul style="list-style-type: none">• Do you think that temperatures are changing? Is it now cooler or warmer than before?• How are seasons changing? Is the rainy season getting shorter or longer compared to 20-30 years ago? Is it raining when it is not supposed to rain nowadays?• Do you think that sea level is rising? Can you recall if the coastline was wider before? How does this affect your livelihood?• Can you recall some major hazards experienced in your area (e.g. floods, droughts, cyclones, heat waves)? <p>For each of the observed changes/hazards, ask how this has affected the environment and ecosystems including:</p> <ul style="list-style-type: none">• crops production, fisheries and livestock• soil and land productivity (short- and long-term effects)• water quality and availability, overall access to water for drinking and irrigation• forests and biodiversity• marine and coastal ecosystems <p>Afterwards, try to find out what does the community do in response to the observed changes and hazards.</p>

How to present the key findings?

Draw a simple table on a large paper/on a flip chart and summarize the obtained information into main points using the above suggested outline.

Tool 2: Group interview with community members with focus on socio-economic profile, observed climate changes and socio-economic impacts

What is a group interview?

A group interview is a type of semi-structured interview, which aims at obtaining community level information.

How to facilitate a semi-structured group interview?

- Prepare a list of key issues in advance and select one person from your group to lead the interview (nevertheless, the other group members can also ask questions)
- Use open-ended questions such as 'what', 'why', 'who', 'when' and ask for concrete examples; if you have questions arising from the given answers, ask new questions
- Try to involve everyone from the focus group to express opinion and share information
- Record the answers

What issues should be explored during the group interview?

The objective of the interview is to obtain information for developing the socio-economic component of the vulnerability analysis including socio-economic profile and impact of observed climate changes on community livelihood. Specific questions are suggested in the table below.

Socio-economic profile	<p>Main productive sectors (agriculture, fisheries, business/industries)</p> <p>Level of household income diversification and overall food security of the community</p> <p>Agriculture sector profile information such as:</p> <ul style="list-style-type: none"> • dominant form of farming (small, medium or large farms) • main agricultural production and level of crops diversification • economic dependency on specific production (e.g. rice or certain type of fish) <p>Financial capacity such as access to credit, loans and insurance.</p> <p>Social issues such as access to education and health care, migration.</p>
Impact of observed climate change on society and economy	<p>Explore people's perception for changes in local climate. Some examples:</p> <ul style="list-style-type: none"> • Do you think that temperatures are changing? Is it now cooler or warmer than before? • How are seasons changing? Is the rainy season getting shorter or longer compared to 20-30 years ago? Is it raining when it is not supposed to rain nowadays? • Do you think that sea level is rising? Can you recall if the coastline was wider before? How does this affect your livelihood? • Can you recall some major hazards experienced in your area (e.g. floods, droughts, cyclones, heat waves)?

	<p>For each of the observed changes/hazards, ask how this has affected the social and economic life of the community including:</p> <ul style="list-style-type: none">• income generation and food security, poverty levels and migration• the productive sectors (e.g. agricultural production loss in a short- and long-term)• the health of the population• the access to education <p>Afterwards, try to find out what does the community do in response to the observed changes and hazards.</p> <p>Finally, ask respondents who are the most vulnerable people in the community such as minority groups and people with disabilities, or those living in a flood-prone area.</p>
How to present the key findings?	<p>Draw a simple table on a large paper/on a flip chart and summarize the obtained information into main points using the above suggested outline.</p>
Tool 3: Group interview with community members with focus on infrastructure profile, observed climate changes and impacts on infrastructure	<p>What is a group interview?</p> <p>A group interview is a type of semi-structured interview, which aims at obtaining community level information.</p> <p>How to facilitate a semi-structured group interview?</p> <ul style="list-style-type: none">• Prepare a list of key issues in advance and select one person from your group to lead the interview (nevertheless, the other group members can also ask questions)• Use open-ended questions such as ‘what’, ‘why’, ‘who’, ‘when’ and ask for concrete examples; if you have questions arising from the given answers, ask new questions• Try to involve everyone from the focus group to express opinion and share information• Record the answers <p>What issues should be explored during the group interview?</p> <p>The objective of the interview is to obtain information for developing the infrastructure component of the vulnerability analysis including infrastructure profile and impact of observed climate changes on community infrastructure and connectivity. Specific questions are suggested in the table below.</p>

Infrastructure profile	<p>Explore the community infrastructure, including what infrastructure, housing and public facilities are available, how are they maintained and are they resilient to climate hazards such as floods and droughts. Consider the following categories:</p> <ul style="list-style-type: none"> • Housing including building materials, design and retrofitting status • Households access to water, sanitation and electricity, e.g. availability of drinking water infiltration wells, hand/motor pumps, tap water, roof-top harvesting systems, sanitation facilities • Main sources of energy and electrification status • Water infrastructure and facilities such as dams, canals, farm ponds, irrigation and drainage systems of agricultural fields • Road infrastructure and accessibility • Flood control/protection infrastructure such as drainage systems, dykes, elevated evacuation routes • Disaster-resilient infrastructure for storage of food and seeds/grains, and shelters for livestock • Access to, and availability and condition of hospitals and public health centres • Monasteries, Pagoda, schools and other community buildings and multipurpose shelters (e.g. cyclone shelters). Explore whether these facilities are available particularly for vulnerable group like children, women, disabled and elderly persons.
Impact of observed climate change on infrastructure	<p>Explore people's perception for changes in local climate. Some examples:</p> <ul style="list-style-type: none"> • Do you think that temperatures are changing? Is it now cooler or warmer than before? • How are seasons changing? Is the rainy season getting shorter or longer compared to 20-30 years ago? Is it raining when it is not supposed to rain nowadays? • Do you think that sea level is rising? Can you recall if the coastline was wider before? How does this affect your livelihood? • Can you recall some major hazards experienced in your area (e.g. floods, droughts, cyclones, heat waves)? <p>For each of the observed changes/hazards, ask how this has affected the housing, infrastructure, public facilities and connectivity of the community. For example: Were there many destroyed houses and roads? Was the access to hospitals and schools affected? Did you have access to water and electricity?</p> <p>Afterwards, try to find out what does the community do in response to the observed changes and hazards.</p> <p>Finally, ask respondents who are the most vulnerable people in the community such as minority groups and people with disabilities, or those living in a flood-prone area.</p>
<p>How to present the key findings?</p> <p>Draw a simple table on a large paper/on a flip chart and summarize the obtained information into main points using the above suggested outline.</p>	

Tool 4: Participatory community and risk mapping

What is participatory mapping?

Participatory mapping is a process of drawing a village/community map based upon information and knowledge shared by local people. It is recommended that women, men, and children from different social groups participate in this process.

Participatory mapping could be used to develop community and hazard/risk maps:

- Community mapping is used to indicate the spatial location of natural resources (main ecosystem services), land-use types (e.g. forest area, agricultural fields and residential areas), important community assets and infrastructure (e.g. roads, bridges, energy grid, water infrastructure and utilities), and other features.
- Hazard/risk mapping could be viewed as an extension of community mapping. It illustrates the hazard-prone locations, as well as people, ecosystems and assets most at risk of hazards such as floods. Other information that could be mapped include: safe areas/route to safe areas, and local capacities such as rescue posts.

How to facilitate a participatory mapping?

- Using the printed map and transparent paper, ask people to draw the map on their own. However, provide guidance with your questions and stimulate discussions on important issues.
- Ask people to provide examples as much as possible
- While community is drawing the map, write down in detail what people say because this information will be used in the vulnerability assessment.

What issues should be explored through the mapping exercise?

The objective of this exercise is to create a spatial profile of the community, including to illustrate the exposure of people, ecosystems, assets, and infrastructure to hazards and climate change impacts (e.g. sea level rise)

The following specific issues could be drawn on the map:

- Spatial location of natural resources and main ecosystem services
- Land-use types (e.g. forest area, agricultural fields and residential areas)
- Important community assets and infrastructure (e.g. roads, bridges, energy grid, water infrastructure and utilities)
- Location of/access to cyclones/emergency centres
- Other features: location of/access to markets, schools, health facilities
- Most at risk locations, assets and people, based upon community's experience from past disasters.

In addition, you can collect other information relevant to support the development of infrastructure and connectivity profile of the community. More specifically, community members could be asked to share their knowledge and experience related to:

- Connectivity challenges during seasonal floods (if relevant to the case study)
- Access to early-warning systems.
- Access to telecommunications (radio, television and the Internet)
- Access to electricity and main sources of energy (e.g. hydropower energy, wood harvesting)
- Main sources of and access to drinking water, household water storage and sanitation facilities

How to present the key findings?

- Together with the produced map, prepare a summary of the obtained information in the form of bullet points (e.g. on a flip chart).

Tool 5: Developing community seasonal calendar to identify observed climate changes and impacts on livelihood

What is a community seasonal calendar?

Developing a seasonal calendar together with communities is a useful tool to identify how recent climate changes affect community livelihood. The calendar could be developed by drawing a simple table on a large piece of paper/flip chart as shown below.

Season (length)	Key events (annual cycle)	Typical climate	Observed changes	Observed impacts
Hot season (March-May)				
Wet season (June-October)				
Cool season (November-February)				

How to facilitate the process of developing community seasonal calendar and what issues should be explored?

Draw the above table and ask people to list:

- Key events (column two), which relate to any significant for the life of a community event during a year such as planting and harvesting, start of school year or seasonal income generating opportunities. Ask what do men and women do, as well as children and elderly, throughout community's annual cycle.
- Climate indicators (columns three and four) could be temperatures, timing and intensity of rainfall, wind patterns, and types and occurrence of hazards. For example, to explore this you can ask the following questions:
 - Do you think that temperatures are changing? Is it now cooler or warmer than before?
 - How are seasons changing? Is the rainy season getting shorter or longer compared to 20-30 years ago? Is it raining when it is not supposed to rain nowadays?
 - Do you think that sea level is rising? Can you recall if the coastline was wider before? How does this affect your livelihood?
 - Can you recall some major hazards experienced in your area (e.g. floods, droughts, cyclones, heat waves)?
- Observed impacts relate to any hardship or loss experienced by community as result of observed changes such as disruption of the annual events cycle. For example, a shift/change in seasonal patterns could affect the growing period, while annual floods may disrupt access to school and affect small-scale producers. Ask about impacts on:
 - Impact on ecosystems (e.g. forest, soil, water resources)
 - Productive sectors (e.g. agriculture, fisheries, livestock, local production)
 - Transportation and connectivity (e.g. access to markets, schools, health services)
 - Access to water and energy
 - Health and social impacts (e.g. impacts on the poorest households, on women and children)

Remember:

- The objective is to identify how recent climate changes affect community livelihood
- Ask guiding questions but leave community members to fill the table on their own
- Ask people to provide examples as much as possible
- While community is filling the calendar, write down in detail what people say because this information will be used in the vulnerability assessment at a later stage.

How to present the key findings?

Together with the produced calendar, prepare a summary of the obtained information in the form of bullet points (e.g. on a flip chart).

Tool 6: Focus group discussion with community members (women and girls) to explore gender roles and vulnerabilities

What is a focus group discussion?

Focus group discussion is a type of semi-structured interview, which aims at discussing a specific topic in detail with a small group of persons who are well familiar with the topic of interest.

How to facilitate a focus group discussion?

- Prepare a list of key issues in advance and select one person from your group to lead the interview (nevertheless, the other group members can also ask questions)
- Use open-ended questions such as 'what', 'why', 'who', 'when' and ask for concrete examples; if you have questions arising from the given answers, ask new questions
- Try to involve everyone from the focus group to express opinion and share information
- Record the answers

What issues should be explored during the focus group discussion?

The objective of the discussion is to understand gender roles in the community and identify vulnerabilities and needs of both men and women. Guiding questions are outlined below.

Understanding livelihood to create community profile	<p>What are the main labour-related activities in your community? What kind of work men do? Is it paid? How much? What do women do, and are they paid? How much?</p> <p>The following aspects could be considered:</p> <ul style="list-style-type: none">• Productive roles: paid work (e.g. agriculture, employment and other income-generating activities), subsistence production• Reproductive roles: domestic work (water, fuel, cooking, market), child-care and care of the sick and elderly• Community-related activities/duties
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	<p>What are the main livelihood assets available in your community?</p> <p>Who has access to these resources – both men and women? How and why?</p> <p>The following aspects could be considered:</p> <ul style="list-style-type: none"> • Human assets: such as health services, education, skills/training • Natural assets: land, water, forest, fish, ecosystem services • Social assets: e.g. social networks, voluntary groups • Physical assets: housing and basic infrastructure (e.g. water, energy), transportation, communications • Financial assets: e.g. credit, loans, insurance
	<p>Who takes important decisions in your community?</p> <p>Are women involved in community decision-making? If ‘no’, why? If ‘yes’ in what way? (e.g. decision on the management of resources and community planning process)</p>
Assessing current vulnerability	<p>What happens when there is flood/drought? How is the community affected?</p> <p>How are men affected? How are women, elderly and children affected?</p> <p>What men usually do in such case? What about women? What are their roles?</p>
Assessing future vulnerability	<p>What would happen in future when the local climate is getting warmer, and rainfall is changing (and sea level is rising)?</p> <p>How would this affect men? What about women? Why?</p>
Identifying needs	<p>Given the expected climate change, what are the needs of your community? What would help you to reduce the impact of climate change?</p> <p>What do women need? What do men need?</p> <p>The following aspects could be considered:</p> <ul style="list-style-type: none"> • Women’s and men’s needs to perform their productive (labour- and income-related) and reproductive (family care) roles under the challenges of climate change • Long-term strategic perspective related to transformation of gender roles in family and community such as increased access to decision-making and resources
<p>How to present the key findings?</p> <p>Draw a simple table on a large paper/on a flip chart and summarize the obtained information into main points using the above table.</p>	
<p>Tool 7: Developing a Potential Impact Pathways graph</p> <p>What is a Potential Impact Pathways graph?</p> <p>Potential Impact Pathways graph is a visual presentation of the complex relationship between projected climate changes, potential hazards and multiple primary and secondary impacts.</p>	
<p>How to facilitate the process?</p> <p>Working in small groups, stimulate discussion using open-ended questions such as these suggested below.</p> <ul style="list-style-type: none"> ■ What would happen in future when the local climate is getting warmer, and rainfall is changing (and sea level is rising)? 	

- How would this affect:
 - environment and natural resources such as land/soil, water, forests, fish, etc.
 - agriculture and food security
 - local production, income and migration
 - access to water and energy, and other services such as transportation and education
 - health of people
 - How would this affect men? How would this affect women? How would this affect elderly and children?

Note: Annex II of this manual could be used as a reference on potential impacts.

Tool 8.1: Developing a list of potential adaptation options

How to facilitate the process?

Working in small groups, stimulate discussion using open-ended questions such as these suggested below. Try to capture all relevant sectors such as environment and agriculture, infrastructure and local businesses, health and education.

Given the expected climate change, what are the needs of your community? What would help you to reduce the impact of climate change? What is your vision for your future?

What do women need? What do men need?

Note: Annex III of this manual could be used as a reference on CCA options.

References:

Ministry of Natural Resources and Environment of Lao PDR (2016). Community-Based Disaster Risk Reduction Manual in Lao PDR. Available at: http://www.adpc.net/igo/category/ID1020/doc/2016-mQHt38-ADPC-CBDRR_Manual_Lao_PDR_.pdf.

V.4 Participant guiding notes and tools for vulnerability assessment (lab analysis): Module 3/Session 3.2

Activities

Activity 2.1. Synthesis of field exercise findings and use of secondary data to complement township profile

⌚ 1-2 hours

- Each group, as divided during the field work, should develop a summary of findings (if possible using computers)
- Group 2 (socio-economic analysis) could use secondary data and generate graphs to show population data disaggregated by sex and age, level of education completed, income per capita, and employment rate.
- Group 3 (spatial analysis and infrastructure) could use secondary data and generate graphs to show type of housing units, household access to drinking and irrigation water.

Outcome of Activity 2.1: completed profile of the case study and synthesis of information necessary to conduct vulnerability analysis.

Activity 2.2. Assessing current vulnerability to climate change and hazards

⌚ 2 hours

- Considering the synthesis information prepared by each group, discuss (in groups and then in plenary) and come up with a list of observed climate changes as stated by community members. Regional observations data will be provided by Facilitator.
- Once the information on observed climate changes is summarized, discuss first in groups and then in plenary, which are the most vulnerable sectors, locations and groups based upon the outcome of Activity 2.1.

Complete this task as follows:

- First, draw a table of three columns to divide environment, socio-economic and infrastructure components of vulnerability. Identify key bullet points to describe the impact of climate change on each of the three components.
- Second, identify which sectors, people and locations have been most impacted from recent climatic stress, an outline why. Here include the findings from the gender analysis as well.
- Third, list non-climatic factors which have exacerbated the severity of climate change impacts (e.g. deforestation, expansion of agricultural land)
- Forth, list the current practices used by the community to respond to climate change and hazards.
- The next step is developing a vulnerability index for the case study. Tool 8 will guide you throughout the process.

Activity 2.3. Assessing future climate change risk and scenario development

⌚ 2 hours

- Refer to the Potential Impact Pathway 2050 developed together with the community.
- Discuss in groups and in plenary future climate risk using the graph as a starting point but considering the community profile and current vulnerabilities identified during Activity 2.2.
- Develop three scenarios: Business as usual, low investment (maintaining current living standard) and high investment (resilient development). Discussion should focus on required response and impact (consequences) under each scenario. Draw your ideas on a flip chart.

Activity 2.4. Developing a long list of adaptation options

⌚ 1-2 hours

- Divide into three groups based upon your sectoral expertise as follows:
 - Environment and ecosystems including agriculture (fisheries, livestock and crops production), forestry, water, other ecosystems and tourism
 - Socio-economic sectors
 - Infrastructure, connectivity and human settlements
- Develop a long list of CCA options. Incorporate the suggestions provided by the community during the field visit.

Tools

Tool 8.2: Developing Community Vulnerability Index

What is vulnerability index?

Vulnerability index is a measure of vulnerability to climate change and hazards used as a tool for identifying and prioritizing vulnerable locations, sectors and groups, among others.

How to develop a vulnerability index?

Step 1: Open the data provided by Facilitator. The following indicators that correspond to key factors of vulnerability will be used in this exercise:

- Exposure to hazards: exposure to floods
- Ecosystem component: access to drinking water
- Socio-economic component: level of education completed
- Infrastructure: type of housing units

Step 2: Group the data values of each variable into four categories as shown below: 1 to measure the lowest and 4 the highest level of vulnerability conditioned by the respective variable.

	Exposure to floods (exposure)	Access to drinking water (ecosystem)	Level of education completed (socio-economic)	Type of housing units (infrastructure)
1	Location in a rain-fed area	50% households having access to surface water and 50% having access to groundwater	75-100% population 25 years and over with high school, diploma or vocational training completed	0-25% houses built with local materials
2	Location close to a seasonal stream	0-25% households having access to surface water	50-75% population 25 years and over with high school, diploma or vocational training completed	25-50% houses built with local materials
3	Location in a flood-prone area (riverbank area)	50-75% households having access to surface water	25-50% population 25 years and over with high school, diploma or vocational training completed	50-75% houses built with local materials
4	-	75-100% households having access to surface water	0-25% population 25 years and over with high school, diploma or vocational training completed	75-100% houses built with local materials

Step 3: Compute vulnerability index using the following formula:

$$\text{Vulnerability Index} = \sum (\text{ecosystem, socio-economic, infrastructure values}) \times \sum (\text{exposure values})$$

Note: 'Value' refers to number of category (1,2,3 and 4).

Example:

Refer to Table 3. Assume that: (i) village A is located close to a seasonal stream (i.e. vulnerability category 2); (ii) 50-75% of the households have access to surface water (vulnerability category 3); (iii) only 0-25% of the population have completed education (vulnerability category 4); and (iv) 50-75% of the houses are built with local materials and hence are not climate resilient (vulnerability category 3).

$$\text{Vulnerability Index for village A} = (3+4+3) \times 2=20$$

Important: The objective of this exercise is to demonstrate how to develop a vulnerability index. In practice, vulnerability indices are used for a comparison. For instance, after calculating vulnerability index for each village in a township, ranking of the most vulnerable locations could be easily performed. This will enable vulnerability assessment teams to identify most at-risk villages.

V.5 Participant guiding notes and tools for strategic adaptation planning exercise: Module 4/Session 4.2

Activities and methods

Activity 1. Defining key issues in township based upon vulnerability assessment results and SWOT analysis

⌚ 2 hours

- Start this activity with an overview of findings from the vulnerability assessment.
- Divide into three groups (as in Activity 2.4/Session 3.2):
 - Environment and ecosystems including agriculture (fisheries, livestock and crops production), forestry, water, other ecosystems and tourism
 - Socio-economic sectors
 - Infrastructure, connectivity and human settlements
- Each thematic group should identify key issues in their area of expertise based upon the vulnerability assessment results.

Example:

- Ecosystem issue: Shorter monsoon season and higher temperatures resulting in water shortage for agriculture and drinking
- Socio-economic issue: Shorter monsoon season and higher temperatures decrease crop production and increase livestock death
- Infrastructure issue: Shorter monsoon season and higher temperatures give less time to collect rain water and increase evaporation
- Working still in groups, conduct a SWOT analysis. Use Tool 9 for guidance
- At the end, each group should record the findings and present them to the large group.

Activity 2. Converting key issues into strategic objectives and specific actions

⌚ 2 hours

- Each thematic group should convert issues into objectives, writing each on a note card.

Note: How to convert an issue into objective?

Converting an issue into objectives relate to expressing how you would like to address (manage, minimize or mitigate) the issue. This is done by combining an action verb that describes a direction of preference (e.g. "increase", "reduce", "maximize"), with a description of the subject (e.g. "reduce risk of coastal storm surges", "improve soil quality" or "reduce farmer's dependency on rice production").

- Organize the identified objectives into higher and lower levels (i.e. main strategic objectives and sub-objectives).
- Having clear hierarchy of objectives, agree upon 1 main strategic objective and 2-3 specific objectives (sub-objectives).

Example: Selected strategic and specific objectives identified for Labutta Township

Strategic objective 1 (ecosystem): Maintain and enhance healthy ecosystem to support living standards

Specific objective: Protect natural resources to support agriculture and fishery

Strategic objective 2 (socio-economic): Enhance socio-economic conditions by diversifying production

Specific objective: Learning new skills to increase employment opportunities in other sectors.

Strategic objective 3 (infrastructure): Ensuring people of Labutta have access to resilient infrastructure to protect people and support development

Specific objective: Increase coverage of hazard-resistant infrastructure

- In the next step, each group should identify short list of adaptation actions by referring to the long list of CCA options identified previously (during vulnerability assessment exercise). These actions should be linked to each specific objective. Use different colours sticky notes to indicate the type of activity as follows:
 - management
 - investment
 - capacity-building/awareness
 - research/analysis

Note: In case actions from the long list remain uncategorised, discuss whether objectives are still relevant and if further objectives are required. Eliminate options that are not feasible or realistic given the capacity of the community.

Outcome of activity 1: At the end of this step, a short-list of options should be identified.

Activity 3. Prioritize CCA actions

⌚ 2 hours

Working in thematic groups as in the previous activity, assess each action (under your thematic objective) against prioritization criteria by assigning score from 1 to 5, whereas score 5 indicates the highest priority. Compute total score for each adaptation action, rank all options and review the results to ensure their accuracy. Use Tool 10 for guidance.

- Select one group member to present results.
- Jointly with the other groups prepare a final list of CCA actions based upon the prioritization exercise.

Tools

Tool 9: SWOT Analysis

Component	Strengths	Weaknesses	Opportunities	Threats
Socio-economic	List any features of the community that could be used to achieve adaptation objectives such as presence of/access to natural resources, and capacities (human, financial, technical).	List any characteristics that could limit CCA, e.g. lack of technical knowledge and financing, poverty, inadequate infrastructure and environmental deterioration.	List any features that create a ground for new developments such as potential for introduction of renewable energy, potential for creating jobs in the industry sector, or potential for forest restoration.	List any factors that pose barriers to/or can undermine climate-resilient development such as land tenure, or expansion of industries that harm the environment (e.g. logging)
Infrastructure				
Ecosystem				

Tool 10: Prioritization of CCA actions

Step 1: Develop a table, which contains the identified in the previous steps Strategic Outcomes, Expected Results and Actions (i.e. short list of adaptation options) as shown below.

Strategic objective (Outcome)	Specific objective (Expected result)	Action	Cost	Feasibility	Community acceptance	Adaptation effectiveness	Benefit anyway	Speed	Score	Strategy

Step 2: Assess each action against the five criteria and assign score to each action under each criterion (e.g. 1 – the lowest, and 5- the highest score). Higher score suggests higher priority. For instance, construction of cyclone shelter could have score 1, which indicates high cost that township may not be able to afford.

The criteria to assess and prioritize CCA actions are:

Cost

Key question: Can this township/community afford this option, and will it bring enough benefits relative to the cost of implementing it?

Feasibility

Key question: Is the technology readily available and will the design, implementation and operation of the action be possible and within the capacity of communities and local government?

Community acceptability

Key question: Would local people accept this action and have ownership of it?

Adaptation effectiveness

Key question: How well would this action work in building resilience to climate change (relative to other options)?

Benefit anyway (no regret)

Key question: Would it bring other development benefits (e.g. raising income, improving education, delivering more services)?

Speed

Key question: Can the action be implemented in a short-term? Will it take long to bring adaptation benefits?

Step 3: Compute the total score for each action and rank all options.

Step 4: Review the results and ensure their accuracy. Discuss the strategic value of each option against the total score and make final selection of priority actions. For example, building cyclone shelter could have lower score due to the high cost of intervention. Nevertheless, it could be of strategic importance for community's resilience and hence prioritized.

Step 5: Verify if the prioritized actions address the most vulnerable sectors, locations and groups (women, children, other marginalized groups), identified through the vulnerability assessment.

Step 6: Develop a final list of CCA actions based upon the outcomes from the prioritization exercise.



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